i-Fi 7 IS COMING: ALL THE BIG CHANGES

apc

JULY 2023 #521

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PRINT POST APPROVED: 100000179
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EDITORIAL

WHAT'S INSIDE *APC*

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Printed in Australia by IVE

Distributed in Australia and NZ by Are Direct

ISSN 0725-4415

Future Publishing Australia
PO Box Q1179, Queen Victoria Building, NSW 1230
Corporate Web: **www.futureplc.com**
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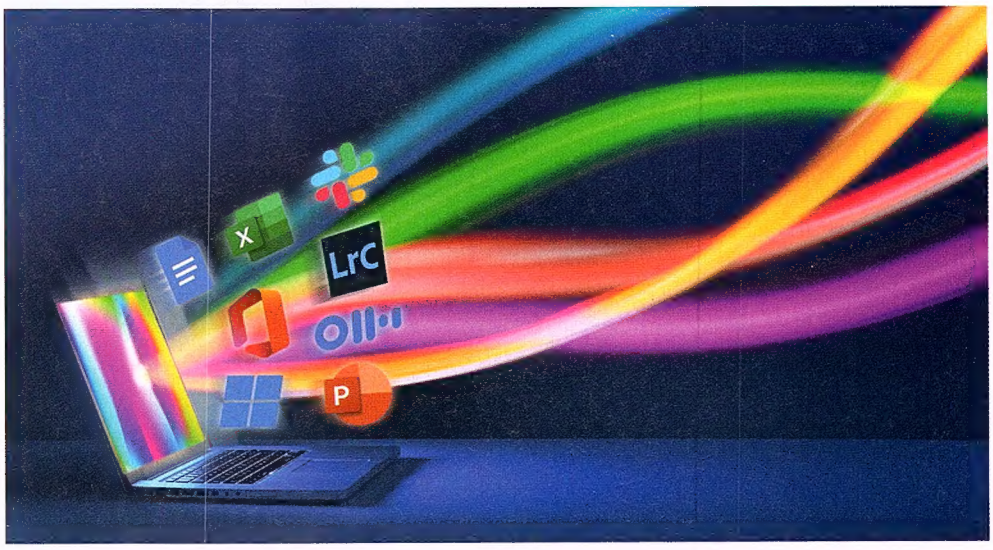

EDITORIAL

Better, faster, stronger

How to hit peak performance?

BEN MANSILL
Is better, faster and stronger than he was yesterday.

Hello everyone. I hope our cover didn't scare anyone too much. We're all working hard, and with the economy in a less than great state, I'm quite sure many of you are feeling the pressure to deliver above and beyond at work, and having *APC* tell you to work faster might be a bit rude – but the last thing we want to do is stress anyone that's already working as fast as they can. Nobody needs that.

But really, our main feature this issue is all about learning a few new tricks for better *efficiency*. It's doing the famous 'smarter', not 'harder'. And there's a lot that you can do to streamline your productivity – and that applies to everyone. You could be a good employee shining like a star at work, a student powering through studies, retired and just mucking around with apps for a personal project, or you could be one of our many internet billionaire readers sitting on a beach making personal wealth PowerPoints on a laptop. There's stuff here for you all!

> "The whole team contributed their personal favourite time-savers for this, as well as some we've collected from readers that previously shared their top tips."

The whole team contributed their personal favourite time-savers for this, as well as some we've collected from readers that previously shared their top tips. It covers many of the most popular apps today, and even if you only take away a couple of time-savers, then you're two steps forward and no steps back. Success!

This issue also sees the start of another magnificent Darren Yates history series. I get more emails from readers telling me they love these than for basically anything else we do, and I know why. These beautifully crafted and deeply researched pieces shine a light on the minor and momentous products, technologies and people that shaped the world we live in today. The road we're setting off on this time is the history of personal computers in Australia, and it's off to a flying start. The first of this five-part series begins on page 70. Enjoy!

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"Four deletion methods ensure a more thorough removal than is possible with Windows' default means."

2

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This easy-to-use Windows software will overwrite sensitive data even up to 35 times regardless of whether they are files, folders, drives, recycle bin or traces of surfing. You can also delete files that have already been deleted, but this time for good.

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"Secure Eraser uses the most renowned method of data disposal and overwrites sensitive information in such a reliable way that it can never be retrieved even with specialised software."

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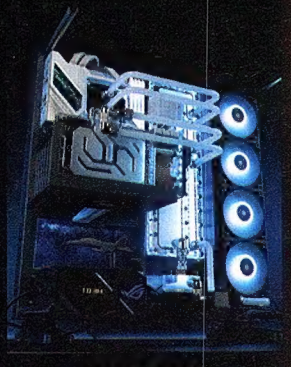

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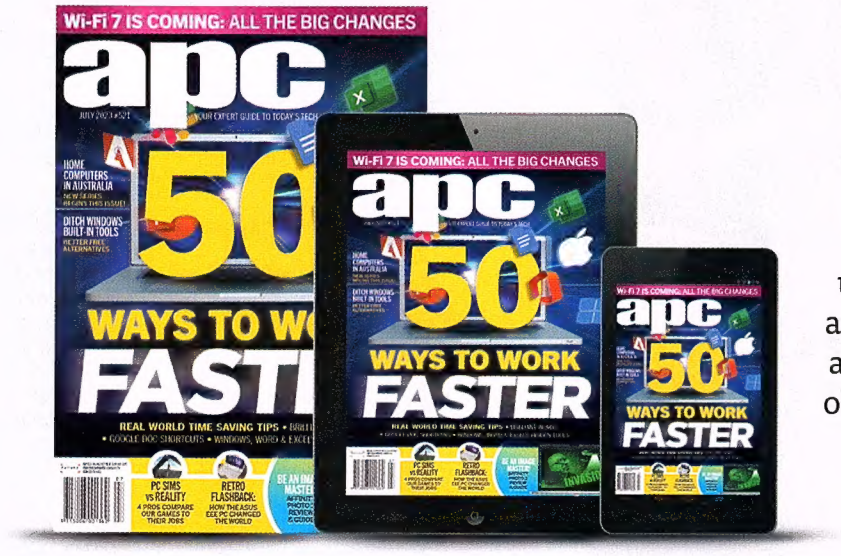
HOW WE DO IT

Inside *APC*

Find out all about APC's editorial policies, test practices, how to read the benchmark results, and more.



"Championing technology doesn't mean we're unrelenting yes-men and -women, however, and *APC* aims to be as objective as possible in all our coverage."

APC is Australia's oldest consumer technology magazine – having been consistently in print for over forty years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, and beyond. We have two goals: to find the best modern tech and to help you make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

Independent reviews

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three attributes.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

Labs testing

APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance including storage read and write speeds, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter offers better ease-of-readability, but tables are more compact, so we use these in most cases where thoroughness is preferred.

UPDATED FOR 2023

apc TESTBED

The current APC testbed used in the Labs for benchmarking all components. This testbed is updated as new and relevant technology comes on stream.

CPU	Intel Core i9 12900K
Motherboard	Asus Maximus Z690 Apex
Graphics Card	Nvidia GeForce RTX 4090 Founders Edition
RAM	2x16GB G.Skill Trident Z5 DDR5-6000
Power Supply	Corsair AX1000
Storage	Seagate Firecuda 530 2TB
Case	Thermaltake Core P8
Cooling	Cooler Master Flux PL360 AIO
Operating system	Windows 11 Pro 22H2

apc AWARDS

apc EDITOR'S CHOICE

APC EDITOR'S CHOICE

When a product scores 4.5 out of 5, it carries the Editor's Choice Award. These are products that exceed expectations and deliver a quality experience up there with the very best.

apc HIGHLY RECOMMENDED

APC HIGHLY RECOMMENDED

You will see this award if a reviewed product has scored four out of five stars. It means most people can expect satisfying performance from the product, and that we would use it ourselves.

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WINDOWS 11 IS GETTING ITS OWN INTEGRATED AI ASSISTANT

POWERED BY BING CHAT AND CHATGPT.

Microsoft is bringing its AI Copilot functionality to Windows 11 as a built-in tool for enhancing productivity workflows. The Windows Copilot feature can analyse content on screen and offer contextual suggestions and actions based on what's being viewed by the user.

The Copilot is accessible via a button on the Taskbar, can be moved around or docked to the right or left side of your screen when running, and features a chat box that runs along the bottom for inputting commands and asking questions. Microsoft says the new Copilot acts like your "personal assistant" for everything Windows, essentially replacing Cortana that came before it. You can ask it to configure Windows settings, open apps, analyse text and images within apps, initiate snap assist, check for updates, and more.

© Google

GOOGLE TERMINATES SUPPORT FOR FIRST-GEN CHROMECAST

NO MORE SOFTWARE OR SECURITY FIXES MOVING FORWARD.

Google has quietly ended support for its first-generation Chromecast dongle, capping off a nearly decade-long run. It is worth pointing out that the last major firmware patch for the original Chromecast was back in November 2022, which itself was the first update in over three years. It appears this end-of-service move was in the works for quite a while.

For those who have an old Chromecast, we strongly recommend recycling the dongle instead of throwing it away. E-waste is a major problem after all, and it doesn't do anybody any good stuffing old gadgets in a drawer or attic. Google has a recycling program for unwanted hardware. The company will send you a free shipping label that you can slap on a box to then send the device back.

BIG MONEY

Nvidia breaks the US$1 trillion market cap threshold

Becomes the first chipmaker to break the barrier.

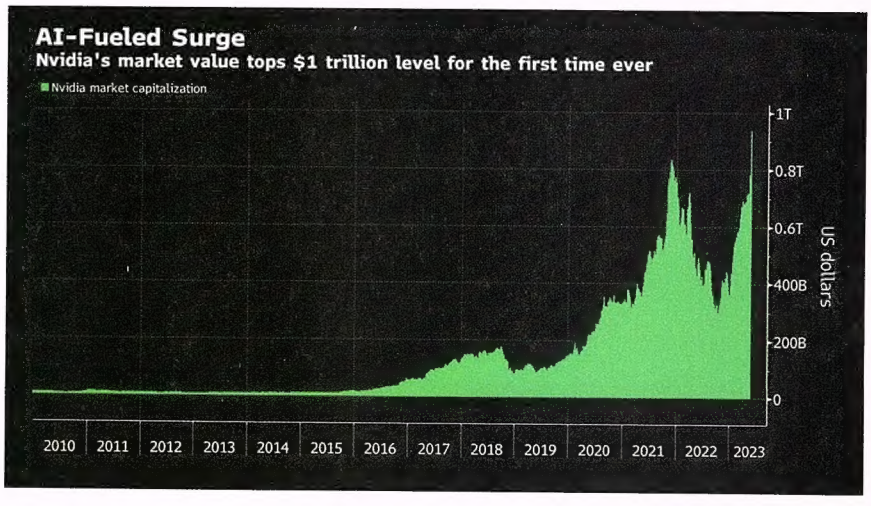
Nvidia became the first chipmaker in history to break the US$1 trillion market cap barrier, reaching US$1.01 trillion as its shares continued to rise amidst the impact of widespread generative AI adoption. Nvidia shares were trading at US$412.71 at the time of writing, a six percent gain over the previous day and a whopping 188 percent increase for the year thus far. As a result, Nvidia becomes one of just six companies with a market cap of over US$1 trillion, joining Apple, Microsoft, Saudi Aramaco, Alphabet (Google), and Amazon in the elite club. Nvidia is also only the ninth company to ever break the US$1 trillion mark.

Nvidia's incredible rise over the course of the year came as generative AI and large language models like ChatGPT have exploded into the mainstream, with blue-chip tech companies like Google, Meta, and Microsoft investing heavily in AI infrastructure to bulk up their AI capabilities.

Nvidia has played a pivotal role in developing the AI ecosystem of hardware and, perhaps more importantly, software powering the AI revolution. With an uncontested lead in AI hardware processing horsepower and the strength of its CUDA software programming model, Nvidia doesn't seem to have a clear opponent for its leadership position.

Nvidia further solidified its position at Computex 2023, unveiling a broad portfolio of new solutions to address a wide range of segments, from massive supercomputers like its DGX GH200 to a new line of reference MGX system designs that will bring AI to mainstream data centres and enterprises. Nvidia is also leveraging the fruits of its tactical purchase of Mellanox to develop its own AI-centric networking infrastructure that ties its solutions together, giving it yet another advantage over its competitors – the ability to design tightly-coupled systems at data centre scale.

For now, Nvidia's biggest problem is satisfying the explosive demand for its GPUs that has led to shortages. Still, the company has made large investments in boosting its production capacity. It is even taking more drastic steps, like courting Intel to have it manufacture its GPUs, to assure that supply constraints at its leading foundry partner TSMC don't hinder its growth.



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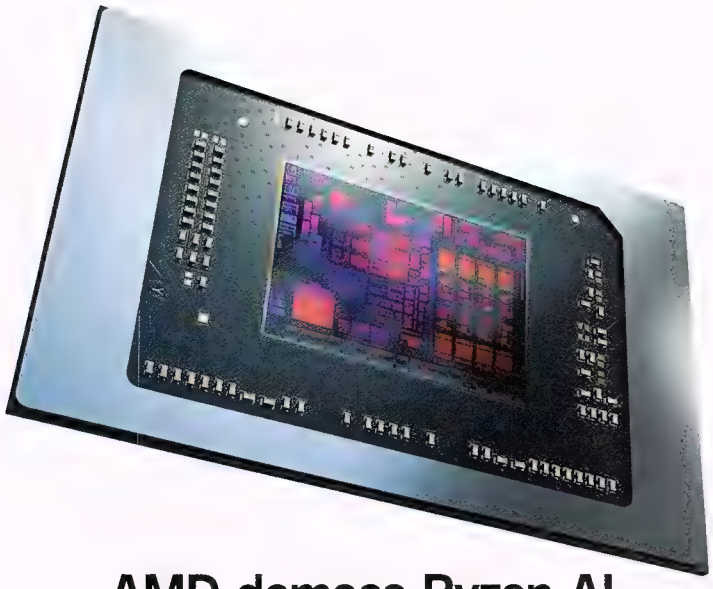


© AMD

AMD demoes Ryzen AI

AI for the masses.

AMD's XDNA AI engine is a dedicated accelerator that resides on-die with the Ryzen CPU cores. The goal for the XDNA AI engine is to execute lower-intensity AI inference workloads, like audio, photo, and video processing, at lower power than you could achieve on a CPU or GPU while delivering faster response times than online services.

This engine can handle up to four concurrent AI streams, though it can be rapidly reconfigured to handle varying amounts of streams. It also crunches INT8 and bfloat16 instructions, with these lower-precision data types offering much higher power efficiency than other data types. AMD claims this engine is faster than the neural engine present on Apple's M2 processors. The engine is plumbed directly into the chips' memory subsystem, so it shares a pool of coherent memory with the CPU and integrated GPU, thus eliminating costly data transfers to, again, boost power efficiency and performance.

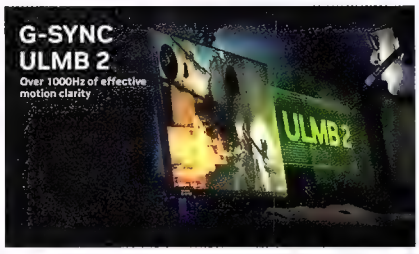
For now, AMD isn't confirming any of its future plans, but McAfee said that while AMD is committed to the AI engine being a part of its future roadmaps, it might not come to all products.

ADATA DETAILS SSD WITH SELF-CONTAINED LIQUID COOLING

Extreme performance meets extreme capacity.

Adata has revealed some details about its NeonStorm solid-state drive with a self-contained liquid cooling system that promises up to 14GB/s sequential read speeds and up to 2M random read/write speeds.

When a NeonStorm generates heat, it is absorbed by a thermal gasket and a metal heat spreader to maximise contact area. This heat is then transferred into a liquid reservoir where it is absorbed by a high-performance coolant, which in turn is cooled down by an aluminium alloy tube that is encircled by the coolant. Meanwhile the tube is cooled down using two fans that blow air from one side to another. The liquid-assisted cooling setup outperforms traditional fan-cooling mechanisms, delivering an impressive 20 percent additional reduction in SSD temperatures, according to Adata.



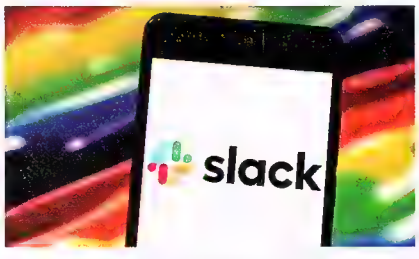
© Nvidia

NVIDIA INTRODUCES ULMB 2

BOOSTING MOTION CLARITY TO 1400HZ.

Nvidia recently announced its second generation Ultra Low Motion Blur (ULMB) technology, dubbed ULMB 2. This update massively improves the technology's capabilities on high-refresh rate monitors, enabling nearly 2x greater brightness than its predecessor and motion blur quality that is nearly 4x greater than current 360Hz monitors – rivalling theoretical 1000Hz to 1400Hz monitors if they existed.

With ULMB 2 active, monitor-based motion blur is effectively deleted, giving gamers excellent object recognition no matter how fast an enemy or object is moving on the screen. It doesn't boost the monitor's response time outright, but ULMB 2 substantially increases the monitor's image quality at the same refresh rate it ships with.



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SLACK FACING WIDESPREAD PROTESTS TO INTRODUCE END-TO-END ENCRYPTION

SLACK OFFICES ARE SET TO BE VISITED BY PRIVACY LOBBYISTS.

More than 90 organisations have signed a letter addressed to Slack asking for end-to-end encryption to be made available on the communications and online collaboration platform, with lobbyists expected to descend on the company's offices today in an effort to raise awareness.

The group cites a 2015 article by *Vice* urging Slack to introduce end-to-end encryption and other old work by journalists and privacy experts, arguing that the Salesforce-owned company is instead prioritsing profits.

As well as a lack of encrypted messages, which can see hackers and law enforcement gain unauthorised access to users' DMs, the consortium also raises concerns over the lack of blocking and reporting tools that should be there to help protect users from abuse. ■

TECH BRIEF

Google's AI search is a content farm on steroids

The search giant is pushing down legitimate results in favour of its own, non-expert advice.

Currently available for testing in limited beta, Google's new Search Generative Experience (SGE) shifts the site from being a search engine that links the best content to a publication offering its own mini-articles. But instead of hiring expert writers to do the work, Google employs an AI that ingests data from human-authored content and spits out weaksauce advice with no expertise or authority to back it up.

Old product listings, poor advice

Let's take this query: "What's the best CPU?" There's a very non-committal set of text (bottom right) saying that you should consider performance, speed and power consumption when choosing a processor (no duh, Captain Obvious). And then there's a list of outdated processors that are not among the best CPUs available today. The top choice is a Ryzen 7 5800X3D which hasn't been the top processor for a year, and then there's a link to a Core i5-10400, which is three generations old. This is not helpful advice.

Giving medical advice without credentials

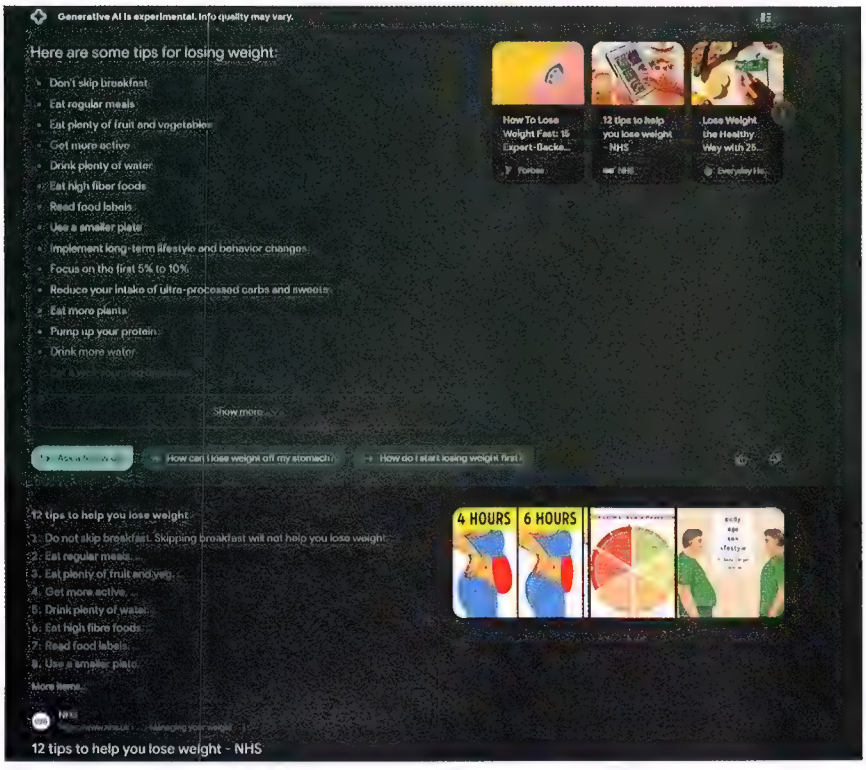
Let's look at a non-tech query and try a seemingly benign question: "How do I lose weight?" The AI bot gives precisely what you'd expect, a list of well-worn weight loss tips that aren't particularly controversial, including "drink plenty of water" and "don't skip breakfast." However, this is medical advice, and it's not attributed to anyone. Who says that using a smaller plate is good for weight loss? Is it a doctor or a nutritionist? What are their credentials? No, Dr. Google thinks that the librarian, not the books, is the real authority.

What we can see (above right) the Generative AI result is Google's old-fashioned featured snippet, which has a lot of the same advice (nearly word-for-word) and links to Great Britain's National Health Service (NHS). So, it seems likely that Google probably grabbed many of these tips from the NHS article but chose not to credit the real medical professionals whose advice we should trust.

"How do I lose weight?" The AI bot gives precisely what you'd expect, a list of well-worn weight loss tips that aren't particularly controversial, including "drink plenty of water" and "don't skip breakfast."

Dangerous for publishers, bad for readers

Let's get this out of the way: I'm not an unbiased party here. As a professional writer, I have a vested interest in people viewing my work and the work of my colleagues at other publications. If people just stay on **Google.com** and rarely leave to visit news and information websites, many of those publications will shut down,


Generative AI is experimental. Info quality may vary.
Here are some tips for losing weight:
Don't skip breakfast
Eat regular meals
Eat plenty of fruit and vegetables
Get more active
Drink plenty of water
Eat high fiber foods
Read food labels
Use a smaller plate
Implement long-term lifestyle and behavior changes
Focus on the first 5% to 10%
Reduce your intake of ultra-processed carbs and sweets
Eat more plants
Pump up your protein
Drink more water
Show more
How To Lose Weight Fast: 15 Expert-Backe...
12 tips to help you lose weight - NHS
Lose Weight the Healthy Way with 25...
How can I lose weight off my stomach?
How do I start losing weight first?
12 tips to help you lose weight
1. Do not skip breakfast. Skipping breakfast will not help you lose weight.
2. Eat regular meals.
3. Eat plenty of fruit and veg.
4. Get more active.
5. Drink plenty of water.
6. Eat high fibre foods.
7. Read food labels.
8. Use a smaller plate.
More items...
4 HOURS
6 HOURS
12 tips to help you lose weight - NHS

Is Google's AI trustworthy with its health advice offerings?

and others will go paywall-only. Readers will have fewer and inferior resources available to them, while Google's bot will draw from a weaker pool of data, making its "advice" even worse.

But let's look at this from a reader's perspective. You are getting advice with no authority behind it. Whether it's buying advice telling you what CPU to purchase or medical advice telling you how to diet or when to get your colon checked, the source of that information matters. You should trust a doctor who is certified. You should not trust some bozo who runs a website selling weight loss pills. By hiding its sources in an attempt to become the publisher, Google stops you from knowing the reliability of the advice.

The SGE assumes that readers, having been trained to "Google" everything, will blindly follow whatever the bot spits out, no questions asked. Google's AI is not a doctor, a tech journalist, a florist or a travel agent. It has no arms and legs to pick up a laptop, install benchmarks and try out the keyboard to see if it's mushy. It has no tongue to taste test food or eyes to watch movies and help you pick the best ones. But it sure can remix existing content!

How Google could make SGE usable

The problem with Google SGE is the mission more than the tool. A helpful generative AI experience would:

- Always cite specific sources with direct links in the copy like Bing Chat does today.
- Not pretend to offer advice: A list of recommended products is advice, as is a list of tips. Any advice should come from a specific human expert. If Google SGE answers queries like "best lubricated switches" at all, it should pinpoint people with expertise, experience and authority in that topic.
- Take up less of the screen: Many people are just going to want links. Don't push all links below the fold, particularly on high-res screens. Making Google's own content take up the entire screen is anti-competitive behaviour.
- Give good recommended links: The quality of the recommended links in the SGE box should match the quality of those in Google's regular organic SERP.
- Don't answer queries where someone is looking for a web page: If I asked for a subreddit or my insurance provider's login page, don't give me your advice. Get out of the way.

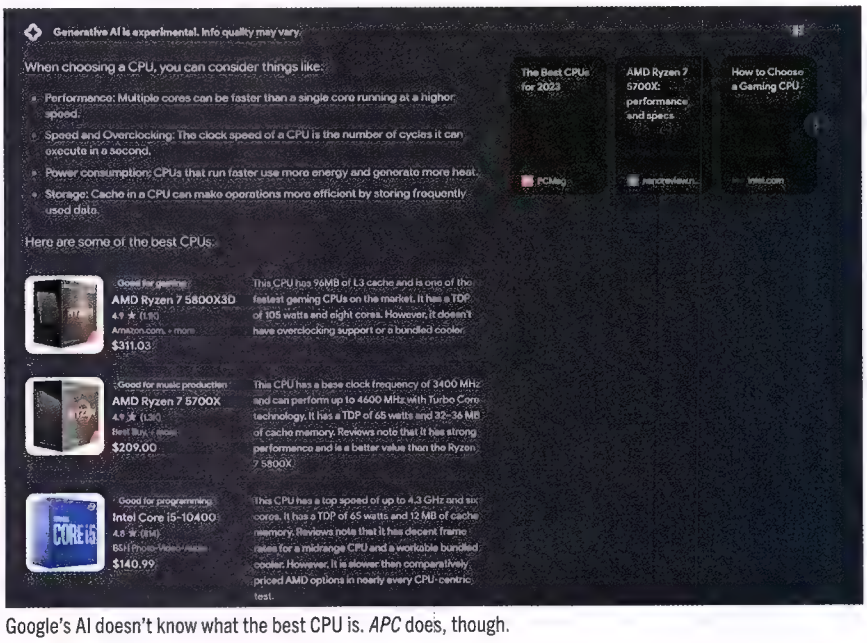
I hope Google will come around to some of these ideas through its testing, but I'm not holding my breath.

Will Google Focus on Profit or User Experience?

Google seems to be betting that, whether the quality of its advice is good or not, most readers will stick with the answers and advice it gives rather than going to outside websites. So if you click a link from Google Shopping, Google is the one that gets paid. And if you stay on Google.com, rather than clicking through to another site, Google gets to keep 100 percent of the ad revenue.

The problem is not that the SGE content is so good that it puts human writers to shame. The issue is that the librarian has become a publisher and is pushing his own content-farm-level output to the forefront. You may not need to write the best book when you have the front shelf.

Avram Piltch ■


Generative AI is experimental. Info quality may vary.
When choosing a CPU, you can consider things like:
Performance: Multiple cores can be faster than a single core running at a higher speed.
Speed and Overclocking: The clock speed of a CPU is the number of cycles it can execute in a second.
Power consumption: CPUs that run faster use more energy and generate more heat.
Storage: Cache in a CPU can make operations more efficient by storing frequently used data.
The Best CPUs for 2023
AMD Ryzen 7 5700X: performance and specs
How to Choose a Gaming CPU
Here are some of the best CPUs:
Good for gaming
AMD Ryzen 7 5800X3D
$311.03
This CPU has 96MB of L3 cache and is one of the fastest gaming CPUs on the market. It has a TDP of 105 watts and eight cores. However, it doesn't have overclocking support or a bundled cooler.
Good for music production
AMD Ryzen 7 5700X
$209.00
This CPU has a base clock frequency of 3400 MHz and can perform up to 4600 MHz with Turbo Core technology. It has a TDP of 65 watts and 32–36 MB of cache memory. Reviews note that it has strong performance and is a better value than the Ryzen 7 5800X.
Good for programming
Intel Core i5-10400
$140.99
This CPU has a top speed of up to 4.3 GHz and six cores. It has a TDP of 65 watts and 12 MB of cache memory. Reviews note that it has decent frame rates for a midrange CPU and a workable bundled cooler. However, it is slower than comparatively priced AMD options in nearly every CPU-centric test.

Google's AI doesn't know what the best CPU is. *APC* does, though.

END USER

Microsoft is losing the console race, for a very obvious reason

The company's console is brilliant, so why can't it compete with Sony? Asks Shaun Prescott.

Shaun is an Australian editor for *PC Gamer*, *GamesRadar* and *PLAY*, and writes for *APC*, *TechRadar* and more.

It was meant to be the big Xbox game of the season. *Redfall* ticked a lot of boxes: developed by the acclaimed studio responsible for *Prey*, *Dishonored* and *Deathloop*, full cooperative support, a sprawling open world, and a neat setting which cast a modern neon-hued bent on cosy small town America. The problem is that it sucked: it's sitting on a 56 Metascore as of early June, and the user score is even worse: 3.5 out of ten.

I can confirm it's a pretty bad game. Not only does it run poorly on Microsoft's flagship Xbox Series X console, but at launch it felt undercooked, half-finished. So unanimous was the criticism that Xbox boss Phil Spencer was compelled to apologise for it: "There's nothing that's more difficult for me than disappointing the Xbox community," Spencer said. "I've been a part of it for a long time. I obviously work on Xbox, I'm head of the business, I have a lot of friends and get a lot of feedback, and just to kind of watch the community lose confidence, be disappointed, I'm disappointed, I'm upset with myself."

Microsoft has done a lot of acquiring, ranging from Mojang through to Bethesda, and is still in the process of securing Activision-Blizzard for $68.7 billion. What it hasn't done a lot of during the last decade, is shipping big tentpole games that scream to the public that Xbox is relevant. Sure, *Halo 5* was decent, and the *Forza* games are reliably fun. Smaller Xbox games like *Pentiment* are brilliant curiosities that Microsoft should be commended for investing in. Xbox Game Pass is still great value.

The problem is that, for going on ten years, Xbox hasn't shipped a new game that can rival the likes of *The Last of Us*, *Uncharted*, or *Spider-Man*, or *God of War*, or even *Horizon: Forbidden West*. To say that Microsoft needs to make great games is as banal as saying that day turns into night, but that doesn't make it any less true. Sure, it doesn't help that Microsoft lost the PS4 / Xbox One generation, which makes a big difference in this age of backwards compatibility, but hit games will surely go a long way towards fixing this. Nintendo's Wii U was a failure, so what did it do? It released a new console and pushed out hit after hit: *Mario Kart*, *Mario Odyssey*, and a new *Zelda*.

As of February Microsoft's unit sales were 18.5 million, with PS5 sitting at 30 million, according to analyst estimates. Microsoft's software release horizon is looking pretty good: *Starfield* (in development long before Microsoft's Bethesda acquisition) will likely be the biggest game of the second half of 2023. *Forza Motorsport 8* is meant to release this year. And there's a long list of first-party games with extremely loose release windows, including new games in the *Fable* and *Elder Scrolls* series.

Xbox has done so many things right: its Series X console is genuinely great, with features like Quick Resume now feeling noticeably absent on competing consoles. Sony's equivalent to Game Pass has yet to offer better value than Game Pass. Its approach to cross-platform play and purchases is consumer friendly. And yet, the company is on the backfoot for a simple, old fashioned reason: Its games are not inspiring the broader public. It's so fundamental that it's easy to forget, that people buy videogame consoles to play the best videogames.

Shaun Prescott ■

"*Redfall* ticked a lot of boxes: developed by the acclaimed studio responsible for *Prey*, *Dishonored* and *Deathloop*, full cooperative support, a sprawling open world, and a neat setting which cast a modern neon-hued bent on cosy small town America. The problem is that it sucked."

'Forever chemicals' might kill EU chip manufacturing

The EU is considering banning PFAS and it's going to have unexpected consequences on Europe's semiconductor supply.

If you have your ear to the ground on environmental issues, you'll probably have heard of a class of chemicals called PFAS, or more colloquially, 'forever chemicals'. Usually found near airports hosting firefighting drills with flame retardant compounds that include polyfluoroalkyl substances (PFAS), the chemicals have become a major focus of environmental regulation in recent years because of their resistance to natural degradation and significant impact on human health. In March the EU began public consultation on a plan to ban the chemicals from all industrial applications, a step that will have major unintended consequences on the global tech industry if not done carefully.

The proposal includes a 13 and a half year transition period for the chip industry, but there are currently no other known chemicals that can replace PFAS chemicals in chip manufacturing. PFAS are integral in the photolithography stage of the manufacturing process as part of the photoresist solution, because it improves adherence to the silicon wafer and overall resistance to temperature and corrosion. The president of the EU division of the semiconductor advocacy group Semi, stated at an industry conference in 2020 "Fluorinated chemicals are essential for semiconductor manufacturing. These specific chemicals are necessary due to their unique properties, and no alternatives are currently available that can adequately provide the functional properties required in semiconductor manufacturing."

In addition to the chips themselves, the chemical-resistant plastics that coat pipes, pumps and seals used by semiconductor manufacturing plants will be even more difficult to substitute according to a report by the Financial Times. The report quotes an executive at a chemical manufacturing plant stating that an attempt to trial non PFAS based gaskets caused leakages 1,000 times higher than when using PFAS ones, an unsafe outcome with potentially worse environmental impacts.

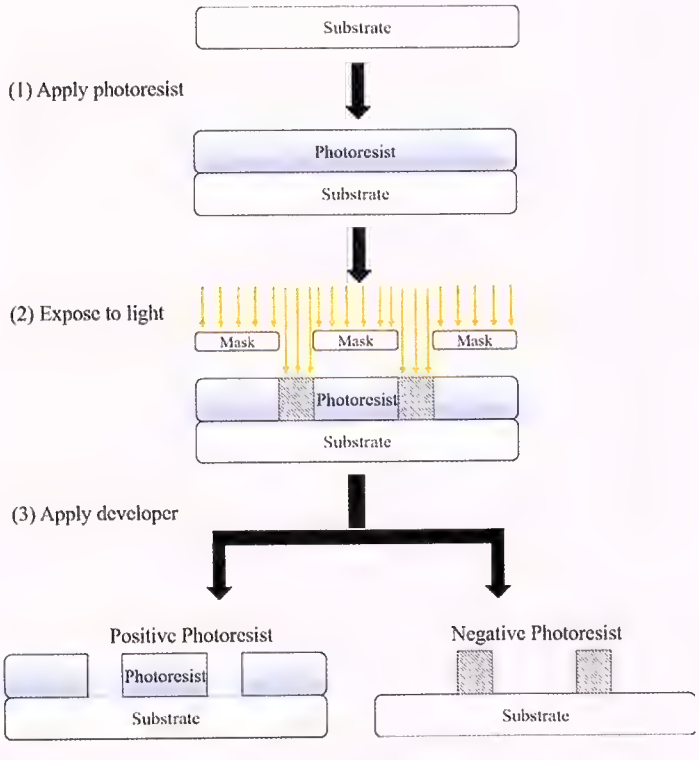
Part of what makes PFAS such a good chemical for insulating and resisting corrosion are the same attributes that make it the most resistant class of chemicals to break down in the environment. This combined with a propensity for water solubility means PFAS that is released into the environment from disposal in the ground (or anywhere else) can leach into the groundwater and be easily transported into rivers downstream. If animals or people do consume water contaminated by PFAS it is difficult to excrete and accumulates in an organism's system over a lifetime. This means that very small amounts can have major implications for human health including altered thyroid function, liver disease, kidney disease, adverse reproductive and developmental outcomes and cancer, according to the National Library of Medicine.

Considering the severity of impacts related to PFAS exposure, it makes a lot of sense for the EU to be working on stringent regulation, but with companies like Intel announcing intentions in 2022 to build a 17 billion Euro mega semiconductor fabrication plant in Germany and up to 80bn in downstream investment, it's an issue that will likely see the brakes put on if not handled appropriately.

Joel Burgess

Joel is one of the senior journalists on *APC* magazine and apart from being the resident laptop, monitor and fitness tech geek, he's also pretty into surfing his local Sydney beach breaks when he's not in front of a screen.

> "The chemical-resistant plastics that coat pipes, pumps and seals used by semiconductor manufacturing plants will be even more difficult to substitute"



PFAS are included in the photoresist component of the photolithography process.

© May Iam CC (Wikipedia)

TWO BITS

Computex is a different beast to E3 and it's back for real in 2023!

Some trade shows are still relevant.

Chris has been elbow deep in PCs since before the turn of the millennium, and he wouldn't have it any other way.

Computex is one of the largest trade shows in the world. After the cancellation of CeBIT in 2018, Computex became the most important computing and information technology event of its type. But is it still relevant in a post Covid world, where so many presentations, product reveals or showcases can be done virtually?

Trade shows were pretty much all called off in 2020 and 2021 (the photos on these pages are from the 2019 show). In 2022, Computex made a return, but strict entry requirements into Taiwan meant it was a hybrid show, with a mix of in person and virtual events.

Sadly, E3 didn't recover from the Covid years with the major exhibitors preferring to host their own events, whether online or in person. In March we got word of the cancellation of the E3 2023 edition, perhaps forever.

Computex remains highly relevant though, and it's a very different kind of show to E3.

APC is proud to showcase the big brands' booths and all the key tech and cool stuff relevant to PCs and gaming. We might show you products from, let's say 30 or 40 vendors covering lots of different bits of tech, varying from things like components to laptops, peripherals and so on. But TAITRA (the organisers of Computex) put out a press release in March saying it expected there to be 1,100 exhibitors and over 3,000 booths.

That's a lot of vendors. Many of these lesser known, if not unknown exhibitors show off all kinds of interesting wares, and plenty of mundane ones too. They're not there to impress the media or get the attention of passers-by. They're businesses there to sell stuff to other businesses. People go there to network and form partnerships. And that's why Computex will always have a future in one form or another.

E3 was mostly a gaming showcase. It's a way for publishers and vendors to hype up their games and wares to the public, either in person or via the media. I'm simplifying things, but its just as easy to release a YouTube video as it is to hold a glitzy keynote that will be viewed by people on YouTube anyway. E3, while beloved, isn't really necessary from an information dissemination perspective.

Gaming is a multi-billion-dollar industry driven by multi-billion-dollar companies. These companies have so much money, they can easily host their own global events, and get 100 percent of the attention and media focus without having to share any of the news cycle.

In short, E3 needs the big publishers more than the big publishers need E3.

In years past, Computex has seen a fair share of major launches, or previews of a new piece of tech or upcoming product. Things like CPUs and new motherboards to go with them as well as graphics cards have all been presented at one time or another. This year appears a bit quiet on that front, though that's likely because of where we are on the major company's release cycles.

We're a long way off a new CPU or GPU launch though we might yet see something from Intel, regarding its next gen Meteor Lake CPUs.

There are always new laptops on display. Expect to see lots of 13th Gen models with Nvidia RTX 40-series mobile GPUs. AMD too will have systems on display including those with its latest APUs, and maybe, just maybe some mobile GPUs. One can hope.

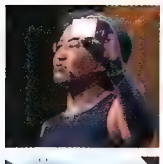
And it'd be remiss of me not to mention the stunning range of case mods and drool worthy systems. Below is a small selection of some of my personal favorites from times gone by. There will be many more on display at the 2023 show.

Storage is one area we should see a lot of action. All the big manufacturers are gearing up to launch their latest PCIe 5.0 SSDs and you can be sure there will be a lot of demo systems showing off big sequential transfer speeds.

There will be truckloads of new peripherals. New keyboards, mice, and headsets will be in abundance as they always are.

APC will have full coverage of all the awesome tech from across the show in our next issue. I'm sure there will be some rubbish too, but it's always interesting rubbish! In fact, one of the most rewarding Computex experiences is finding a weird or whacky product on a lesser trafficked aisle, or for that matter finding a hidden gem.

Chris Szewczyk ■



"*APC* is proud to showcase the big brands' booths and all the key tech and cool stuff relevant to PCs and gaming."

PCIe 5.0 SSDs are finally here

So when does the flood of product begin, and will it be worth upgrading?

Jarrod Walton
Jarrod has been described as an AI by people he meets at parties.

The PCI Express 5.0 specification was finalised on May 29, 2019. The first PCIe 5.0-ready consumer platform arrived with Intel's Z690 chipset and socket LGA1700 platform in November 2021. But PCIe 5.0 graphics cards and SSDs were nowhere to be found.

In fact, outside of certain Nvidia data centre H100 solutions, PCIe 5.0 GPUs are still not here, but after waiting for over a year, the SSDs are starting to trickle out. The first crop of PCIe 5.0 M.2 SSDs all use Phison's E26 controller. Coupled with the controller is a single LPDDR4 DRAM chip. All the 2TB Phison E26 products we've looked at so far are using a 32Gb IC, or 4GB of total RAM – twice the amount we'd expect to see. Whether that's necessary to hit higher performance levels isn't clear, but we've seen the same configuration on the Crucial T700, Corsair MP700, Inland TD510, and Gigabyte Aorus Gen5 10000. But the NAND is perhaps the bigger story.

The E26 is an eight-channel controller, and it can be paired with NAND operating at up to 2400 MT/s. Everyone so far is using Micron 3D NAND with 232 layers, but no one is using the maximum 2400 MT/s speed. In fact, most of the drives are using 1600 MT/s. That's enough to go well beyond PCIe 4.0 speeds, but we're not yet maxing out the PCIe 5.0 spec. Most of the drives are rated for 10,000 MB/s reads and 9,500 (give or take), though the Crucial T700 is the exception. It has 2000 MT/s NAND and is rated for 12,400 MB/s reads and 11,800 MB/s writes.

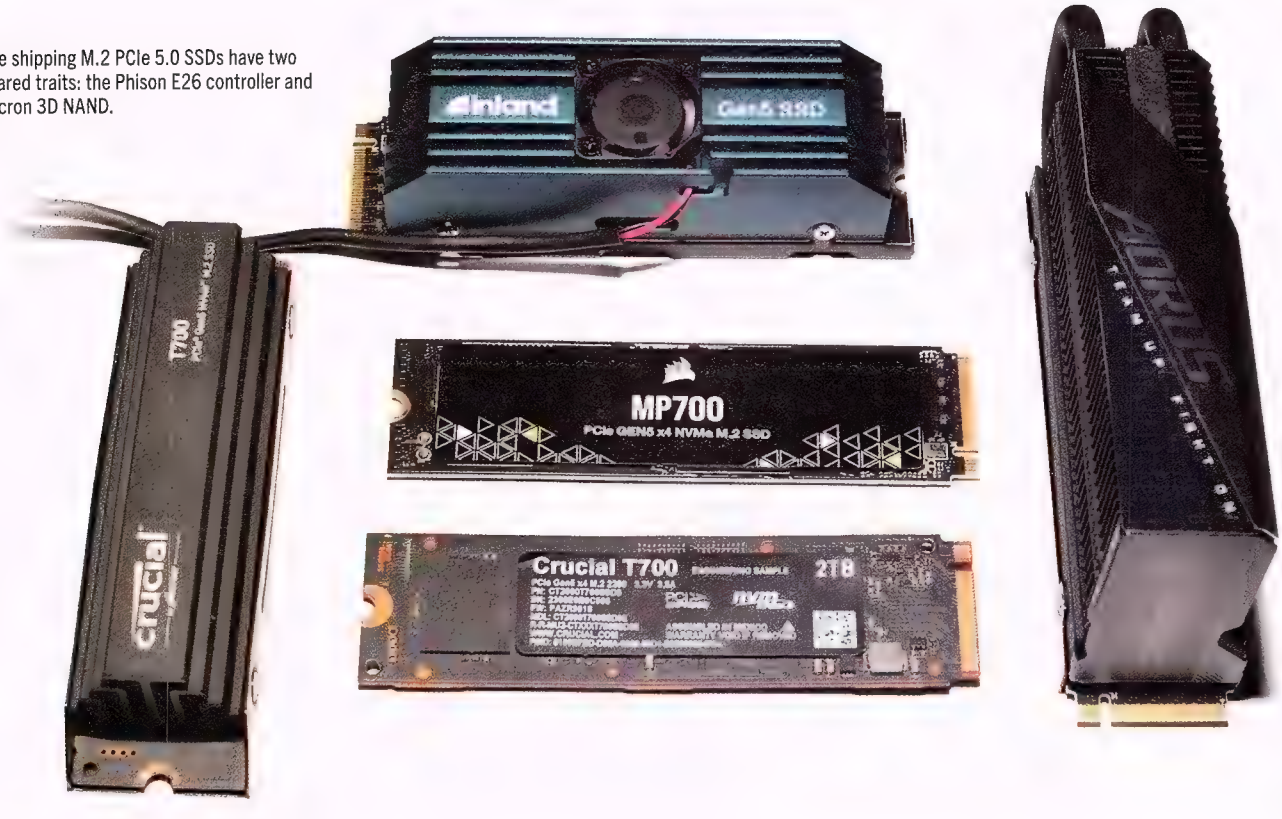
That might sound very fast, and it is. The real-world benefits, on the other hand, aren't particularly noticeable. PCMark and 3DMark storage tests put the Gen5 drives at roughly 10–15 percent higher bandwidth than the fastest Gen4 SSDs. Copy testing was 15 percent faster as well, though the T700 was 20 percent faster than the top Gen4 drive. Only synthetic tests like Crystal Disk Mark and ATTO were able to show larger improvements. Latencies and useful random IOPS weren't significantly changed.

Even if the performance is good, there's still the power to contend with. These Gen5 SSDs all idle at around 3W of power. That's not a problem for high-end desktops, but it's not going to work with a laptop – not that any laptops currently offer PCIe 5.0 support. The higher interface speeds require more power, and PCIe 4.0 is still fast enough for all but the most demanding storage workloads.

But there's another knock-on effect: all these Gen5 drives require decent cooling. Is it necessary? Not in our testing, though in PCs with less airflow it might help. Corsair's MP700 was supposed to include a fan and heatsink as well, but Corsair axed that, and instead requires that the motherboard have a sufficient cooler.

But never mind this. The PCI Express 6.0 specification was finalised in January 2022, and PCI-SIG is already working on PCIe 7.0. When will we get 6.0 platforms and drives? Check back in a couple of years.

Jarrod Walton ■



The shipping M.2 PCIe 5.0 SSDs have two shared traits: the Phison E26 controller and Micron 3D NAND.

TRADE CHAT

Everybody chill, PC sales are not imploding

The situation is actually very normal.

Jeremy Laird
Has a black leather jacket just like Jensen's.

PC sales nosedived by about 30 percent in the first quarter of this year. But that is no reason to panic – pretty much all digital devices have taken a hit of late. Besides, if you bother to give the numbers more than a cursory glance, you'll see that PC sales are remarkably strong.

To get more specific, two leading research outfits have released numbers for PC sales covering the first quarter of 2023, and it's not pretty. Canalys reckons PC shipments tanked by 32.6 percent compared to the same period in 2022, while IDC puts it at 29 percent. Cue tales of woe across online media and the broader commentariat.

IDC notes that PC sales now are worse than before the pandemic, implying that the fall is more than a mere readjustment following an uptick in sales during that stay-at-home period. But that isn't actually right. Instead, even taking the recent drop into account, PC sales are still up overall.

For several years prior to the pandemic, PC sales ran at about 60 million units in the first quarter of every year, and then roughly 65 to 75 million for each of the remaining three quarters. But during the bizarre pandemic boom, shipments ran at 80 million units plus for seven consecutive quarters, two of which were up around 90 million.

The fact that PC shipments fell back to the mid-to-high 50 million mark in the first quarter of this year, depending on whether you use Canalys or IDC's figures, does not mean PC sales have tanked. On the contrary, overall PC sales are still massively up over the last couple of years.

> "If anything, the real story is how little that demand has dipped."

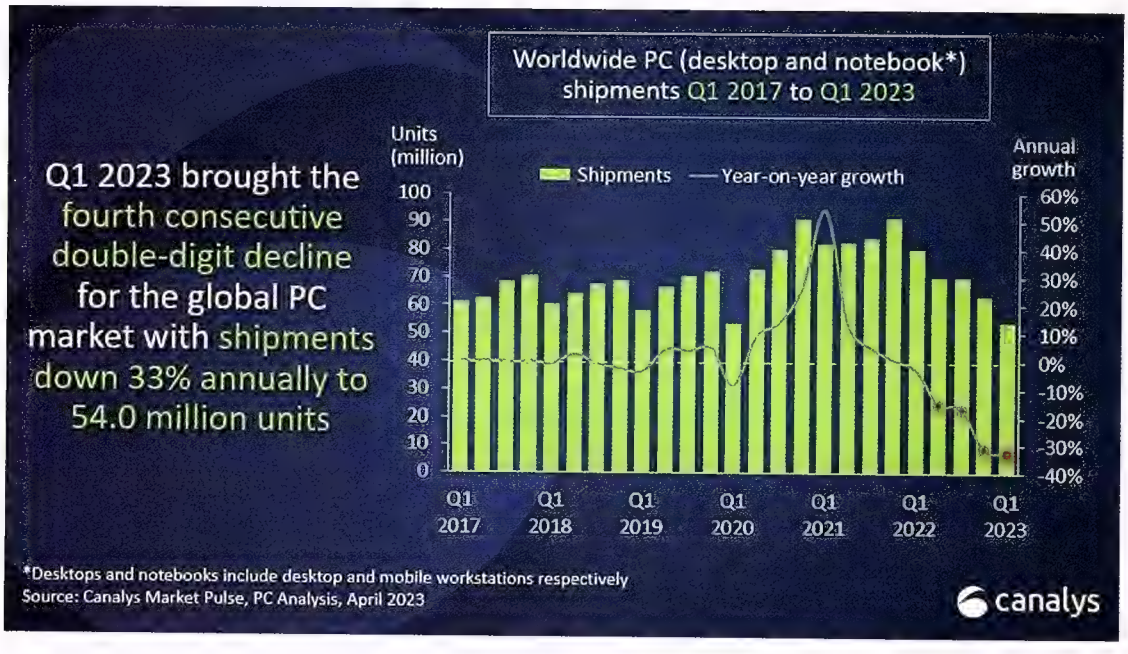
A whole bunch of PCs got bought from late 2020 through early 2022 – far more than usual – and those PCs do not already need replacing. Those purchases almost certainly brought forward upgrades that would have happened a little later on. The net result is that demand is now flagging a little.

If anything, the real story is how little that demand has dipped. You might think that if something like an extra 100 million extra PCs were bought during the pandemic then volumes would dip by a similar amount once life went back to normal, but we've actually seen only a small dip. Even more remarkably, analysts are predicting an upturn in shipments in the second half of this year. If that happens, the net impact of the pandemic years will unambiguously be more PC sales.

None of this leaves the analyst industry looking too clever. All you have to do is briefly scan their graphs with the knowledge of that stay-at-home inspired spike in demand to understand what has been going on.

It's a classic case of not being able to see the wood for the trees. That and the temptation for these companies to favour the most superficially technical and jargon-infused narratives, the better to look clever and justify pricey access to the longer versions of their market research. Observing that everyone went a little crazy buying stuff during the pandemic and that's catching up with the market a little doesn't fill the pages of a premium-access report as effectively as reams of interest rate analysis and millimetric plotting of growth curves, as if profound insights lie therein. We've all got to earn a dollar, I guess.

Jeremy Laird ■



Making movie magic the new way

The film industry's Vegas exploits definitely aren't staying there.

Las Vegas is a curious place. I have come nearly every year since 1990, often twice a year, lured by the best conferences in the world. The scale of the facilities, both within the hotels and the enormous Las Vegas Convention Centre, defy belief.

The two conferences that justify the flights, the hassle and the eye-watering prices on the main Strip are CES in January and NAB in April. Whilst CES is useful from a professional perspective, it's not where my heart lays. That's at the NAB Show, an orgy of pro video, audio, TV and film technologies. Technology that starts in the professional world of film, TV and broadcast soon filters into the mainstream of the consumer space.

So trends that you spot at NAB usually turn out to be very prescient. A decade ago, the story was all about 4K, with companies such as RED and ARRI bringing cameras to market. Now 4K is the minimum baseline, with 8K and 12K becoming more mainstream.

Why am I telling you this? Because there is one of those once-in-a-decade generation shifts happening right now. Back in the day, studios filmed against green screen, and used dots on the actor to perform motion capture. They relied on techniques such as rotoscoping to composite together complex images.

Today all of this is trivial. The industry went green screen, but actors found it hard to relate to a tennis ball on the end of the stick, representing the face of a CGI character which hadn't yet been built. Building 3D sets in a computer and then placing people into them became the norm.

But the seismic shift I speak of is moving away from green screen to a full virtual environment. The problem with a green screen background is precisely that. The actors can't see the world that is being created. So how about taking huge high-resolution video walls, and creating a curved space in which the talent can work? You build the virtual background and show it on the screen. It's high enough resolution that you might not need to cut it out and reinsert the raw imagery back in.

Now it's possible to have a seamless environment of fore/midground with real props and objects, and then to have the farfield in the video wall. Generating these huge high resolution video images is ideally suited to engines such as Unreal, and there is a clear crossover from the games world to TV and film production. The final clever part? Tracking the camera position in the 3D physical space so that the correct farfield image can be generated on the fly.

For the TV and film industry, this is a revolution. No longer do you have to rely on physical sets and having the right time of day. Now it will be possible to build all of that, and to mix reality with virtual generation into one seamless experience that does away with green screen.

And guess what? The prices are low, and falling fast. This will bring a new era of film and TV democratisation. What is affordable by the big players today will be affordable by film schools and ordinary users tomorrow. And the answer to the question "is it real or is it computer generated?" will become irrelevant.

Jon Honeyball ■

Jon Honeyball
Jon Honeyball is 3D-generated.

"The industry went green screen, but actors found it hard to relate to a tennis ball on the end of the stick, representing the face of a CGI character which hadn't yet been built."

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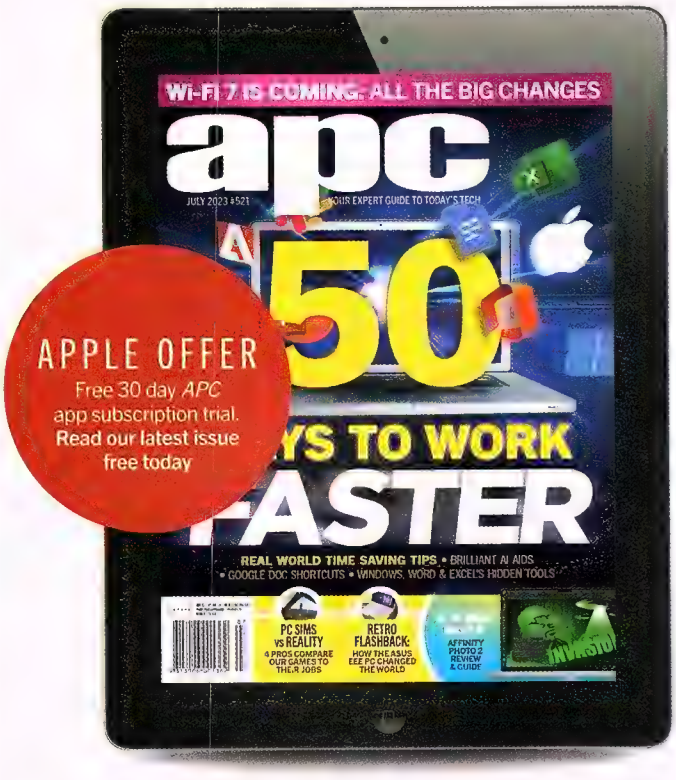
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FUTURES

WE EXPLORE THE TRENDS AND TECHNOLOGIES THAT ARE SET TO SHAPE THE FUTURE

The sad reality: why this won't be the year of AR

Whether it's rumours of Apple releasing an AR headset or Meta's push to the metaverse, many predict that 2023 will be a turning point for augmented reality. Nicole Kobie finds it hard to agree.

There are few technologies that have stumbled to market on such a meandering path as display headsets. Be it virtual reality, augmented reality, mixed reality or extended reality, the final reality has proved underwhelming. But expectations continue to be high, with some suggesting that 2023 will finally be the year that changes everything, as Facebook-parent Meta goes all in on VR and even Apple releases hardware. Perhaps.

We've been promised such glory before. The first headset was made back in 1968 by Ivan Sutherland and his team of students at Harvard. It showed 3D images laid over reality, making it augmented reality before the term virtual reality was even coined. After a host of VR failures in the 1990s – such as Sega VR and Nintendo Virtual Boy – Palmer Luckey popped up with a Kickstarter for the Oculus Rift in 2012, which was two years later snapped up by Facebook, now Meta, for $US2 billion. It's since sold 20 million devices in its Meta Quest lineup – not quite a mainstream success, but hardly a failure.

Then there's AR. Google Glass and Snap Spectacles failed to take off, and Magic Leap disappointed with its first launch before pivoting to enterprise. Microsoft's HoloLens 2 is still around, but the firm had to reassure developers that support for its enterprise AR headset would survive recent layoffs, with its virtual meeting room closed.

That's the short version of the history that Meta and Apple are hoping to disrupt – and no wonder, with analyst firm Technavio predicting AR will grow by 28 percent to $231 billion by 2027. But does anyone actually want to wear always-on augmented reality glasses even if the two tech giants manage to crack the technology?

Duncan Stewart, of Deloitte Canada, doesn't think 2023 is the year that happens. "Both [AR and VR] have been predicted to be large markets growing at 50 to 100 percent for years now," he said. "This has been going on for nearly a decade, where people have been saying this is the year it's going to be huge – and it keeps not happening."

Tough tech

Why exactly is that? VR headsets have improved, but have also become more expensive, notes Stewart. "This limits consumer demand, it limits enterprise demand," he said, adding that's especially true during tough economic times. "At the start of 2022, people were looking for VR sales to grow strongly, but they declined about 20 percent."

AR is an even tougher problem as the technology still needs work. Users are promised constant access to their data and updates at the glance of an eye, but are

instead saddled with heavy glasses with short battery life and unimpressive displays.

"There are AR goggles that are thinner and lighter... and don't give you motion sickness, but the problem is they don't do much – they can display text and coloured images, but only if it's not bright outside," Stewart said. "The resolution is not that high and colour saturation isn't good."

One solution to the display issue could be micro-LEDs, which in theory enable bright and clear and colourful AR glasses without using much power, but that's likely years away. "They're incredibly hard to scale," Stewart said.

Matthew Ball, venture capitalist and author of The Metaverse And How it Will Revolutionise Everything, points out in a blog post (**tinyurl.com/APC521meta**) that augmented reality both has more work to do and tougher constraints than virtual reality. A game console is plugged in for power, doesn't need to track your movement or eyes, and the weight and size don't matter. A VR gaming headset needs to be light enough to wear, track movement and have connectivity. AR glasses need to be lighter still yet packed with technology.

He figures AR glasses need to weigh less than 150g to be worn all day like normal "dumb" glasses, but they need to do so while carrying their own battery. All of this before you factor in displays, speakers, microphones and sensors; all while analysing and understanding what the person sees in the real world and digitally. It's a lot of work crushed into a tiny amount of space.

This is why enterprise devices are expensive and used for short periods of time. Ball points to surgeons trialling devices where most of the hardware is offloaded to computers under the operating table, in the same way that Sony's VR2 gaming headset is powered by a PlayStation console.

If there was one ray of hope, it was to be found at CES. There, Israeli firm Lumus demoed a lightweight pair of glasses with a 2 x 2K resolution that were comfortable to wear and displayed sharp, bright images (300cd/m2). Lumus is rumoured to be supplying the engine behind Apple's glasses.

Top: The Lumus Z-Lens 2D waveguide glasses delivered an AR surprise at CES 2023.
Above: Microsoft's HoloLens 2 is still around, but only just.

Meta and Apple look to AR

After changing its name to Meta, the company formerly known as Facebook remains all-in on the metaverse. Well, 20 percent in. In November 2022, CEO Mark Zuckerberg responded to investor concerns that Meta was sinking too much money into its Reality Labs division with the response that "about 80 percent of our investments – a little more – go towards the core business".

He added: "Still the vast majority of what we're doing is, and will continue to be, going towards social media for quite some time until the metaverse becomes a larger thing."

In March, Zuckerberg showed off its plans for VR and AR to employees. On the VR front, Meta plans to release a thinner version of its Quest 3 VR headset that also features cameras on the front for augmented features, rather than fully immersive viewing, similar to its high-end Quest Pro.

Meta also reportedly plans to release a follow-up to its Ray-Ban smart glasses, which can take photos via voice controls and share what you capture. Future versions, due in 2025, will be able to display text messages and connect to a "neural interface" to add hand gestures and be typed on like a keyboard. But true AR glasses aren't expected to arrive until at least 2027, and then tech enthusiasts will be targeted first rather than mainstream audiences.

Apple, meanwhile, has been less clear about its plans. It has been quietly working on a headset of some sort for years, with a report in the New York Times detailing a meeting five years ago where Jony Ive unveiled a concept video of an AR headset in action. Ive left the company in 2019 and no headset is yet to arrive, though reports suggest a $3,000 ski-goggle style design will be announced this summer – if internal concerns about the price and the technology don't derail the launch.

And perhaps they should – that's a lesson Google learned from Glass. The firm now known as Alphabet unveiled Glass in 2012 as a beta product to be sold directly to developers, despite internal concerns the product wasn't ready. And it clearly wasn't, never going on wide release before being finally yanked from sale in 2015. It subsequently returned as an enterprise product, but that too is no longer being sold.

In the meantime, researchers continue to work with existing headsets to find ways to solve problems and add features. Academics at MIT developed an app for Microsoft HoloLens that lets the user "see" an object marked with an RFID tag that is beyond their range of sight, a tool that could be useful for warehouses or in manufacturing, to find the right part or component. And in another recent announcement, Snap unveiled AR Enterprise Services, a platform for building AR tools. That includes a Shopping Suite that makes it easier to build apps for customers to virtually try on clothing using a smartphone.

Below: The Nintendo Virtual Boy was an early VR failure.

VR for now

VR headsets continue to muddle by in the consumer market – though, as Stewart notes, they often aren't well used even when they do make it into gamers' homes, with fewer than one in ten headset owners using them

Left: Headsets have great potential for use in industry, but have yet to truly take off.

daily. That's microscopic when compared to smartphones, but also pales into insignificance compared to smartwatches: not only do these outsell VR headsets by about ten to one, but they're used with much more regularity. That makes it easier to sell subscriptions, apps and other content.

Things look more promising when you switch to the business market. Enterprises have found intriguing ways to make use of VR for training, simulations and medical applications. There's also a growing use case for exploring digital twins, Stewart says, letting you walk through a digital version of a hospital, for example.

Where VR isn't being used is in meetings, as video calls seem to suffice for most office workers.

"There are some applications where it's a good thing, but putting on a headset isn't what most people want to do to make a call," Stewart said, adding that goggles still make some people feel ill. At Mobile World Congress, a demo being shown to a colleague couldn't go ahead because the company rep didn't like wearing the headset as it made him throw up. "If you want to know why it hasn't taken off, the fact that a company can't do a demo because they don't like the technology tells you more than any number of research reports."

The enterprise market has been held back by hardware fragmentation, says Rolf Illenberger, CEO of enterprise software company VRdirect. Differing features make it possible but difficult to develop content for multiple headsets – though that means limiting development to meet the lowest-common denominator, rather than whizzy features and top-end specs – and procurement is challenging when manufacturers yank support with little warning.

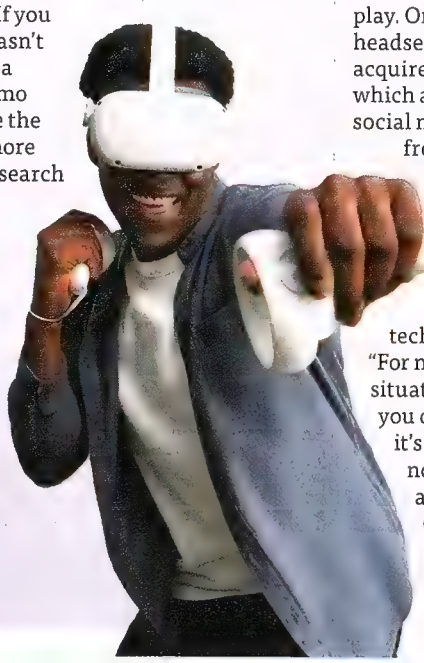
That happened with one VRdirect client, a major carmaker that bought 150 Oculus Go headsets only to have Meta ditch support a few months later. "The development curve is on an exponential growth rate," said Illenberger. "The next device generation feels so much more improved, but you have outdated devices in a fairly short time period."

That has held back the enterprises from stepping into VR, as they wait for the market to calm – or at least for Apple or other big players to step in. "It's absolutely key that [the] Apple headset will be released in a timely fashion, because that will keep decision makers within enterprises from postponing the decision any longer with regard to what kind of ecosystem they're going to greenlight for a global rollout," Illenberger said.

And geopolitics are coming into play. One of the most popular headsets is made by Pico, recently acquired by China's ByteDance, which also owns TikTok, the social network under pressure from US politicians. Chinese PC manufacturer Lenovo is also set to release its VR headset soon.

"We're going to head into a China vs US situation with this new technology," said Illenberger. "For most companies, the situation is a nightmare because you don't trust Meta – because it's Meta and you've learned not to – and your alternatives are from China."

Below: It may be that VR and AR are confined to gaming.



What's next

As the headset market evolves, the acronyms are becoming more jumbled. Facebook's Quest Pro has front-facing cameras to allow some AR capabilities, which is what Illenberger predicts the Apple headset will also feature. This is an idea dubbed mixed reality, or MR. "I think we have to be realistic about these MR features on the road to AR," said Illenberger. "The reality is that Apple is likely to release a VR headset with an MR capability – what it really means is they didn't master AR in the time frame they were looking at."

Like Stewart, Illenberger agrees that true AR is years away. "AR has the capacity to replace smartphones as the number one device that humans are using to interact with technology – but that's probably a 2030 thing," he predicted.

One upside is that gives the industry plenty of time to play with MR and get the content right for these devices. "It's not just the technology, you have to have a compelling ecosystem," said Illenberger. Apple is obviously a master at ecosystems, and it's clear Meta has tripped up with its early interpretation of the metaverse, with low numbers of returning users to its virtual space, Horizon. "What does that say? It's probably not enough to just have a virtual space," said Illenberger. "That's not what people are attracted to – and Apple knows that."

All this suggests that 2023 isn't AR's year and perhaps it won't be for some time. Indeed, there's a chance that VR remains a niche gaming product and enterprise tool while AR fails to ever take off, argues Stewart – and it has nothing to do with technology, but with human reticence to wear something on our faces. After all, plenty of people, Stewart included, pay to have laser eye surgery to avoid wearing glasses.

"We by and large prefer not having things on our faces – is that an innate human behaviour that means augmented reality will never be as popular as the smartphone?" he wondered, admitting it's impossible to know for certain until the hardware is ready. "The advantages of wearing these [headsets] will have to be strong to be as successful as smartphones." ■

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THE A-LIST

The A-List

The best products on the market, as picked by our editors.

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PREMIUM LAPTOPS

APPLE MACBOOK PRO 16IN (M2)

STUNNING CREATIVE POWER

All the upgrades to this 2023 model are within, as Apple's M2 Pro and M2 Max processors take charge. Combine this power with the 16.2in mini-LED screen, superb sound system and phenomenal battery life, and you have the world's premier workstation laptop.

From $3,199, apple.com/au

ALTERNATIVES

DELL XPS 15 (2022)

Surely the best Windows all-rounder money can buy, with a slim design, gaming potential and plenty of power courtesy of Intel's 12th gen Core processors.

From $2,924, dell.com

APPLE MACBOOK AIR

The MacBook Air M2 looks like a standout to us. A powerful and quiet ultraportable with an unbeatable battery life and a great pro display.

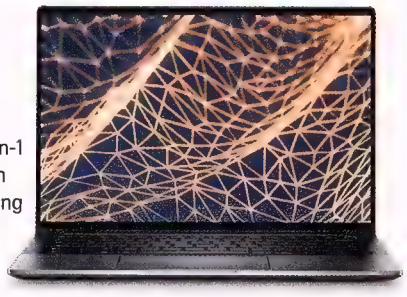
From $1,899, apple.com/au

MICROSOFT SURFACE PRO 9

APC rates the Intel model highly, the SQ3 model less so. With Intel, you get a solid upgrade to the world's leading detachable tablet laptop.

$2,549, microsoft.com

BUSINESS LAPTOPS



Dell Latitude 9330 2-in-1

FLEXIBLE BRILLIANCE

This is a brilliantly made 2-in-1 that's flexible both in design and configuration. Everything screams quality, from the wide-gamut 13.3in matte screen to the enhanced features for Zoom calls – including a superb 1080p webcam, mics and speakers.

$5,031, dell.com/en-au

ALTERNATIVES

LENOVO THINKPAD T14 GEN 3 (INTEL)

An awesome keyboard, slim design, customisable spec and fine selection of ports make this a great business laptop.

$2,529, lenovo.com/au

ACER TRAVELMATE P6

Not the most powerful due its 11th gen Core chip, but a great 14in screen and keyboard, superb battery life and competitive price lift it above rivals.

$2,799, acer.com

DYNABOOK PORTEGE X40L-K-101

A simply brilliant 1kg 14in laptop that excels in all areas, including superb battery life. Buy the K-105 for $2,193 if you can live with a Core i5 processor.

$2,543, anz.dynabook.com

GAMING LAPTOPS

RAZER BLADE 15 (2022)

A SUPERBLY ENGINEERED GAMING POWERHOUSE

Right now there's just not another better gaming unit around. It's miraculously thin considering the beefy components inside, thermals are very well managed and the Razer Blade 15 manages to extract very good performance from its GPU without undue throttling. There are many variants and options, and they're an outstanding buy if you find one on sale. **~$4,499, razer.com/au-en**

ALTERNATIVES

LENOVO LEGION 5I PRO (16IN)

A great-value gaming laptop that's extracts the most from its powerful components. We really love the keyboard, too.

From $2,649, lenovo.com/au

■ NEW ENTRY

RAZER BLADE 18

A great advert for 18in gaming laptops, the Blade 18 partners a Core i9-13950HX with RTX 40-series graphics in a stunning, slim design.

$8,499, razer.com/au-en

■ NEW ENTRY

ASUS ROG STRIX SCAR 18

It's expensive, but if you want an 18in laptop that delivers all-out power this is the no-compromise 3.1kg beast to buy – it packs quality everywhere.

$7,499, asus.com/au

EVERYDAY LAPTOPS

MICROSOFT SURFACE LAPTOP GO 2

FEELS LIKE A PREMIUM ULTRABOOK, BUT COSTS HALF AS MUCH.

A solid update to an amazingly good value mid range ultrabook. It runs cool and quiet, and has up to 30 percent better battery performance than its predeccessor, all in a beautifully designed form with a superb keyboard and trackpad.

From $1,099, microsoft.com/en-au

ALTERNATIVES

LENOVO YOGA SLIM 7 PRO

A powerful, well designed ultrabook with an awesome OLED screen for a good price. The original 2-in-1 bends into a new clamshell shape.

$1,699, lenovo.com

HP ENVY 13 (2020)

It may not be the world's most exciting laptop, but the Envy 13 is a compact and forward-looking machine that's ideally suited to these homeworking times.

$1,699, store.hp.com

HP PAVILION 14

This slim 1.4kg laptop is a superb choice for anyone on a tighter budget. it struck an excellent balance between speed and battery life – around ten hours.

From $999, store.hp.com

CHROMEBOOKS

ASUS CHROMEBOOK FLIP CX5

The best big-screen Chromebook we've tried, with a bright 15.6in Full HD display with decent black levels and surprisingly rich colours. And it's a good specification for the price, with a Core i3 processor, 8GB of RAM and a 128GB SSD in tow.

$1,213, asus.com/au

LENOVO FLEX 3 CHROMEBOOK

This isn't the most powerful Chromebook, but students need reliability more than power – especially if they're only really using it for homework, note-taking, and perhaps the occasional bit of Netflix.

$484, lenovo.com/au

LENOVO IDEAPAD DUET

The Chromebook answer to Microsoft's Surface tablets, this is a seriously versatile device – albeit not the speediest (although we never found it to be painfully slow while carrying out everyday tasks). For this price, and with a 16hrs 14mins battery life, the Duet is a great choice.

$899, lenovo.com/au

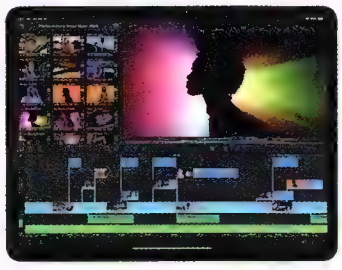
TABLETS

APPLE IPAD PRO 12.9IN (2021)

M1 POWER IN YOUR PALM

Blurring the boundaries between laptop and tablet like never before, the M1-powered iPad Pro 12.9-inch is every bit as fast as we expected – and the "Liquid Retina XDR" display is simply phenomenal.

From $1,649, apple.com/au



APPLE IPAD (2021)

Apple performs its usual trick of upgrading just enough to keep the iPad affordable and up to date, without treading on the toes of its more luxurious stablemates. The big bezels remain, but a faster processor, more storage and improved camera all add to its appeal.

From $499, apple.com/au

SAMSUNG GALAXY S8 ULTRA

The Samsung Galaxy Tab S8 Ultra is an enormously impressive tablet. It makes a fantastic first impression with its gorgeous screen and thin body, and is great for multitasking. If you want the best Android tablet going, there's no question at all that this is it.

$1,499, samsung.com

EVERYDAY MONITORS

NEW ENTRY

MSI MEG 342C QD-OLED

THE BEST PANEL OF 2022 AT A MORE AFFORDABLE PRICE.

Quantum Dot technology combines with an OLED self-emitting panel to offer brighter, more efficient and more colourful visuals than your average OLED screen.

$1,799, msi.com

EIZO FLEXSCAN EV2480

Businesses in particular will love this easy-to-roll-out 24-inch monitor, with its exceptional five-year warranty, USB-C port for easy docking, excellent viewing angles and delicious whites. And it has the best OSD around.

$699, eizoglobal.com

DAHUA DHI-LM28-F420

This affordable 4K monitor might not offer much in the way of menu options or high-end gaming perks, but it offers impressive resolution and colour.

$269, dahuaaustralia.com.au

PROFESSIONAL MONITORS

EIZO COLOREDGE CG319X

CREATIVE MASTERCLASS, $7,119

As the price indicates, this monitor is for heavyweight creatives who demand the best in every discipline: HDR video editing, print layouts, professional photography and more besides. With superb coverage and accuracy across all spaces, plus a built-in calibrator, it justifies the investment.

$7,119, eizoglobal.com

BENQ PD2725U

By no means a cheap 4K 27-inch monitor – unless you compare it to the Eizos – but it marries all-round quality with ease of use thanks to a puck that allows you to quickly move between settings. You can even daisy chain a second Thunderbolt 3 monitor for a monster setup.

$1,799, benq.com

EIZO COLOREDGE CG279X

Designers who need to work across different disciplines will love how easy it is to switch between the Adobe RGB, DCI-P3 and sRGB colour spaces using the Eizo's fantastic OSD. It's certainly not cheap for a 27-inch 1440p monitor, but it's packed with quality.

$3,095, eizoglobal.com

HOME OFFICE PRINTERS

EPSON ECOTANK ET-1810

BACK TO BASICS

There's nothing flashy about this bottle- fed inkjet: it's there to churn out pages at a decent rate (8.8ppm for black text) for a low price. It comes with enough ink for 4,500 black pages and 7,500 in colour, but refills are cheap. Just don't expect features like duplex printing.

$299, epson.com.au

CANON PIXMA PRO-200

Yes, it's big and it's expensive – and you don't even get a scanner – but the Pixma Pro-200 means that you can print A3 photos with glorious colour accuracy and detail. If you're after an office workhorse, look elsewhere, but it can't be beaten on photo quality.

$809, canon.com

BROTHER MFC-J4540DWXL

Home workers will love this inkjet all-in-one. It combines an incredible range of features with all the connectivity you need and extreme ease of use. Output quality is fine, it offers the best cloud support around and the high-capacity ink pack could keep you going for years.

$420, brother.com

WIRELESS ROUTERS

SYNOLOGY WRX560
THE PERFECT ROUTER
Its quad-band Wi-Fi smashed-through our performance tests managing 791.5Mbps up close, 375Mbps two rooms away and an amazing 216.7Mbps down the garden..
$599, synology.com/au

■ NEW ENTRY

ASUS ROG RAPTURE GT-AX16000
The most splendid, overpowered router on the market. But, it's silly money and aspirational to most users. Ultimately, though, it's currently the highest-spec consumer router available.
$1,299, asus.com/au

SYNOLOGY RT6600AX
Fast, well-featured and secure, the Synology RT6600ax is as perfect for professionals and prosumers as much as it is for SMBs and smart homes, and the app and interface are a delight to use for both experts and plug and play users alike.
$599, synology.com/au

MESH WI-FI

TP-LINK DECO XE75 AXE5400
SUPERB WI-FI 6 MESH
Offers the simplicity, speed and range most people want from a mesh system. While it's expensive, nothing else offers the plug-and-play simplicity, speed and range afforded by the Deco XE75.
$999, tp-ink.com

TP-LINK DECO X20
The price below isn't a typo: the Deco X20 makes it possible to upgrade your home network to Wi-Fi 6 – as well as manage its security – for the price of some standalone routers. The included HomeCare functions are also a great bonus for households where lots of devices are fighting over the bandwidth. **$199, tp-link.com**

ASUS ZENWIFI AX
The interface and design certainly aren't the prettiest (the nodes look like mini space heaters, while the charcoal version is straight out of the 1980s), but if you're after strong performance, great features and plenty of expansion potential, the ZenWiFi AX is a compelling prospect.
$949, asus.com/au

NAS SERVERS

QNAP TS-130
SIMPLE HOME NAS
An above average CPU and RAM combo, solid features and affordable price make the QNAP TS-130 worth considering. Alternatively there's the two bay TS230 which features the same CPU, with 2GB of RAM, dual drive bays, and an extra USB port on the front for a modest $50 price increase.
$250, qnap.com

ASUSTOR NIMBUSTOR AS5304T
This is a hugely powerful four-bay NAS that will be overkill for most people – not just due to its speed but also its slightly intimidating user interface – but techies and gamers should investigate the Nimbustor AS5304T for both its speed and flexibility.
$799, asustor.com

SYNOLOGY DISKSTATION DS1522+
At $1,199 it's not cheap but factoring in the software means it's great value. Though some internal silicon may lack headroom, this is still a well-featured, expandable NAS with fantastic software. The best part is the DSM software.
$1,199, synology.com

SECURITY SOFTWARE

G DATA TOTAL SECURITY
A suite for power users with a host of useful features that offers formidable protection against viruses.
US$49.95, 1 device, gdatasoftware.com

ALTERNATIVES

AVAST ONE ESSENTIAL
The only product in our tests to score a 100% protection rating for blocking all malicious files, this reliable choice is our pick of the free AV tools and includes a free if limited VPN service..
Free, avast.com

MCAFEE+ ADVANCED
A high-end choice with high-end features and support for an unlimited number of devices. Good value for the first year, but watch out for renewals.
$139.95, individual, unlimited devices, mcafee.com/en-au

VPNs

NORDVPN
NordVPN provides consistent and fast speeds, serious security, great support for video-streaming services and some cost-effective subscription rates.
$59 per year, nordvpn.com

ALTERNATIVES

PROTONVPN
ProtonVPN provided one of the best free offerings of all the VPNs in our group test, including unlimited data, but upgrade to benefit from even faster speeds and many more options.
Free, protonvpn.com

SURFSHARK
A strong rival to NordVPN, especially if you're willing to commit to its two-year contract. It's fast, cheap and a fine choice for people who like to switch to US streaming services.
$66.34 for one year, surfshark.com

PASSWORD MANAGERS

BITWARDEN
Bitwarden has a huge advantage: it's free. It isn't as slick as some paid-for rivals, but it can sync passwords across all devices for no extra charge. **Free, bitwarden.com**

ALTERNATIVES

DASHLANE
A manager that's ideal for beginners, and it even builds in an unlimited (if basic) VPN service. Note you may prefer to buy the Family plan ($60 per year) as this extends the service to six people.
$55.99 per year (Premium), dashlane.com

1PASSWORD
1Password is targeted at technically minded users who are looking for the last word in security. It even offers a Travel Mode that may ease your mind if surrendering your phone to customs officials.
$54.99 per year (individual), 1password.com

THE LIST

The top five CPUs for gaming

With the release of the AMD Ryzen 7 7800X3D, we're now able to see how the current-gen CPU market shakes out for gamers. The good news is that you don't need a huge budget to get a processor that will give you great performance and last for years to come, although as always, you can still up the budget if you want something that does more than just game. Here are our top picks.

1

INTEL CORE I5 13600K

$485, www.intel.com

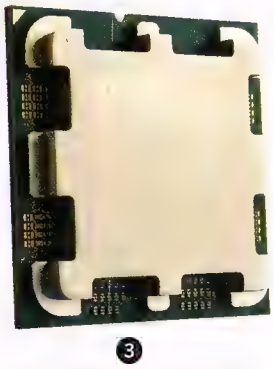
We love Intel's mid-range chip, which will be the right CPU at the right price for the vast majority of PC gamers, as it matched the previous-gen top-end Core i9 12900K in many of our tests. Real-life performance doesn't match up in every regard, but it delivers something similar in gaming for a lot less money. It's also a all-round powerhouse for editing, streaming, and anything else you care to ask of it.

2

INTEL CORE I5 13400F

$319, www.intel.com

For a gaming PC, there's no better-value CPU than a Core i5. The 13400F is only a handful of frames shy of the nearly three times as costly Core i9 13900K in *Total War: Three Kingdoms* and *F1 2021*. There are some anomolies though in a handful of titles like *Far Cry 6* and *Shadow of the Tomb Raider*, which were a lot slower than on Intel's high-end processors. But you can't argue with the value here.



3

AMD RYZEN 7 7800X3D

$749, www.amd.com

There is an argument to be made for the AMD Ryzen 7 7800X3D being the best gaming CPU around. It's certainly the best gaming chip that AMD has ever made, but it's also outperforming Intel's top CPU when it comes to gaming frame rates, and doing so for a lot less cash. It's not as good at other workloads, but while it's not a jack of all trades, it certainly is a master of gaming.

4

INTEL CORE I9 13900K

$849, www.intel.com

Intel's current top-end consumer chip is a fantastic workhorse that you can confidently throw at any challenge, including high-end gaming. That also applies to multitasking and creative workloads – this thing has 24 cores, and is perfectly suited to lots of demanding stuff happening all at once. We also like that the chip has support for older motherboards and DDR4 RAM, meaning you might not have to spend money upgrading your whole system to join in on the 13th-gen fun.

5

AMD RYZEN 9 7950X

$875, www.amd.com

Although now slightly superceded by the AMD Ryzen 9 7950X3D, you are at least able to get a bit of a bargain on AMD's previous top-end CPU. It's still the best all-round AMD processor at present, with a fancy new heatspreader design, and while it certainly gets worryingly warm, it's also blazingly fast. Our Cinebench R23 tests saw this chip tipping the odd core up to a crazy 5.9GHz under load. ■

HEAD TO HEAD

Slack vs Discord

Battle of the chat apps – which should you use?

■ **Slack** Slack Free $0.00, Slack Pro US$7.25/month, Slack Business+ US$12.50/month, www.slack.com
■ **Discord** Discord Free $0.00, $12.99/month, www.discord.com

Communication is key. Yes, that's an old saying, but it's something that is especially true in the modern digital age, where we stay in touch with friends, work colleagues, even family. In order to build strong communications, you need an equally strong application to make things as simple and clear as possible. That's where these two apps come in.

Whether you're after a corporate or more gamer-focused app, Slack and Discord are two of the most prominent connectivity platforms to choose from. Both essentially offer the same service, but with unique features that set them apart, it's often difficult to decide which one to primarily use. Let's pit them against each other and figure out which one will be victorious.

In the grand scheme of things, both apps are fairly new to the party, with the oldest, Slack, releasing in August 2013, while Discord came out in May 2015. Yet despite being relatively young, they have made quite an impact, with millions of active worldwide users.

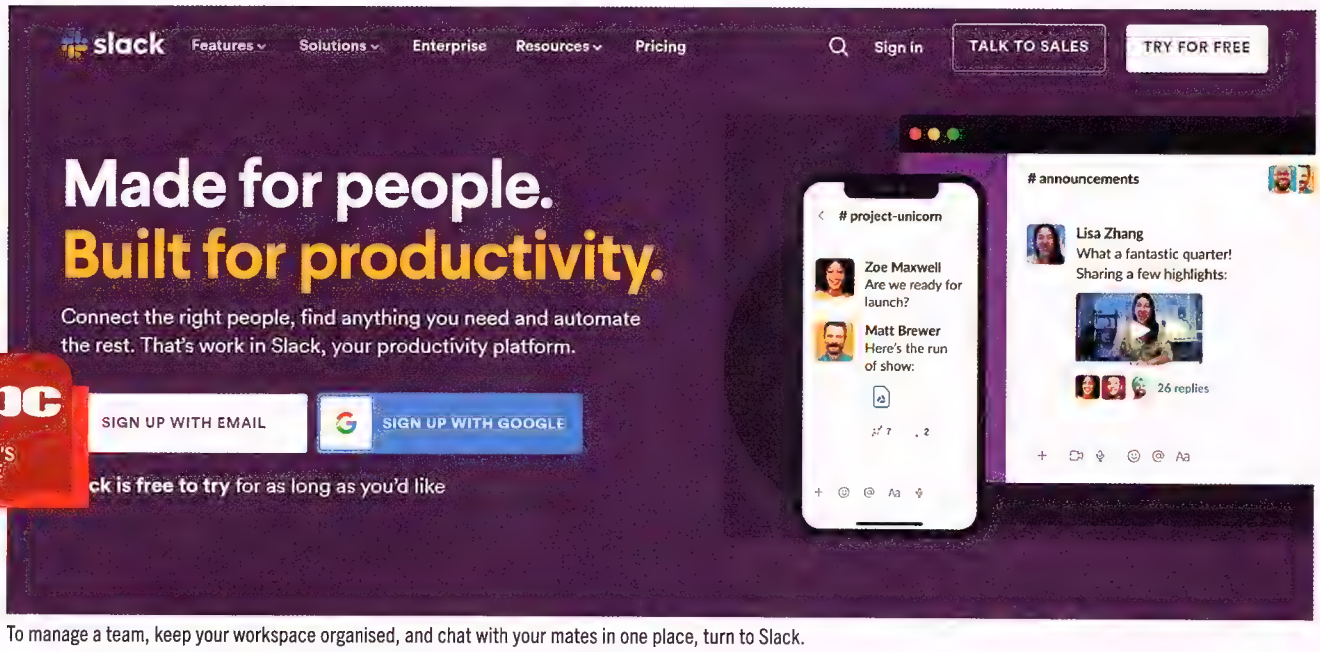
Slack was created by founder Stewart Butterfield, who knows a thing or two about software services as he one of the co-founders of photo sharing site Flickr. Butterfield and his team accidentally kick-started Slack by starting to develop something for the massively multiplayer online role playing game market. In 2009, they created a gaming developer called Tiny Speck, working on the MMORPG Glitch. It was a unique title as it didn't have combat mechanics, and was based on a 2D platform design with surrealist and fantasy-esque aesthetics. It was popular with a loyal but sadly small audience.

During its development, the team had to think of a way to improve communication, as they were spread across Vancouver, New York, and San Francisco, despite only being a tiny team of four. To overcome working across different time zones, they used an application that was popular during the late '80s and '90s, Internet Relay Chat (IRC). It was okay, but Butterfield knew they needed a more reliable way to communicate, so they started creating their own in-house tool.

By 2012, Glitch had a slim limelight, and unfortunately wasn't sustainable due to a lack of audience. This prompted the team to focus more on its own communication tool, which was slowly being developed over time. One issue with IRC was it wasn't asynchronous. This is something that had to change with what would become Slack. It meant that messages would be waiting for you once you logged in. The two other features that are still prevalent in Slack are centralisation and transparency. Instead of using a multitude of applications, you can share files, email, meet, and keep everything organized. Slack's design language is what makes it so successful within businesses – it keeps a clean UI with plenty of colors to help organise things.

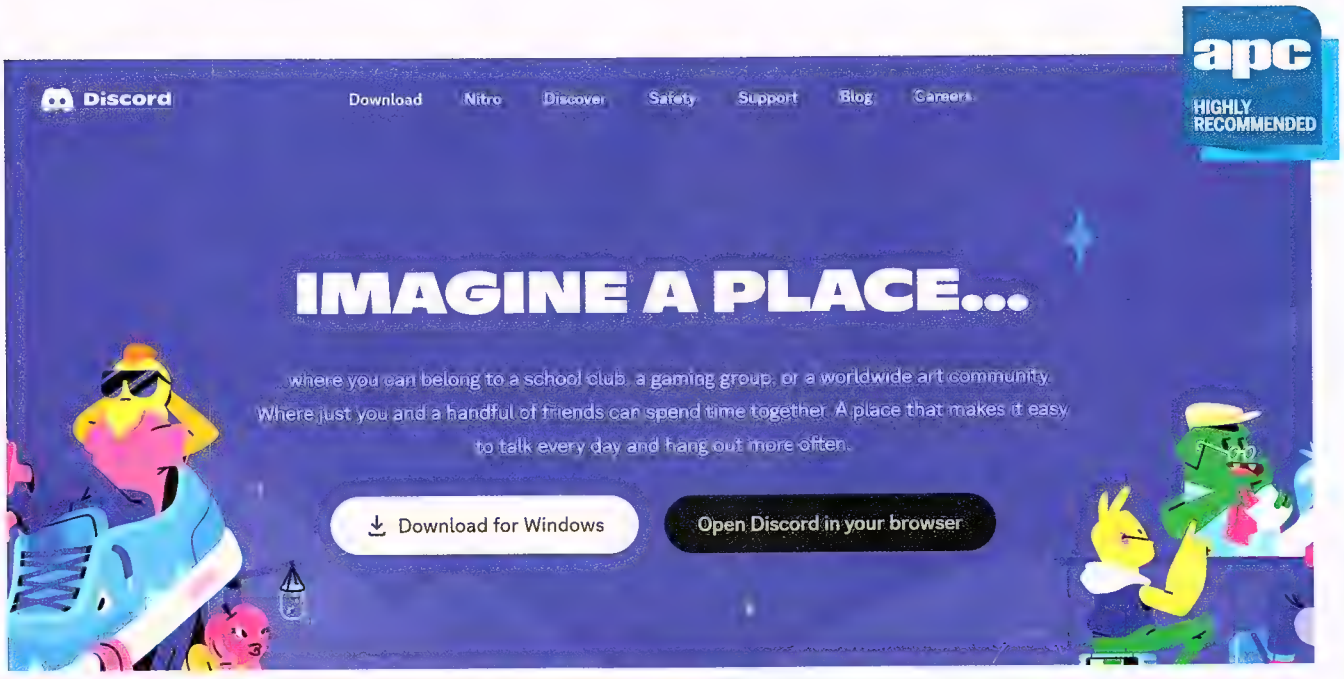
With somewhat similar humble gaming beginnings, we welcome Discord to the server. It started to solve one major issue at the time within the PC gaming sphere, communicating with friends. Founders Jason Citron and Stan Vishnevskiy, both die-hard gamers, were very fond of the connections and friendships developed over the years through their passion for gaming. Although other systems were in place to communicate online at the time, they knew they needed to create a more reliable, quicker, and easier-to-use tool in order to achieve a more seamless gaming party experience. This in turn should create stronger bonds between gamers and improve their experiences.

It wasn't until 2015 when Discord – what Jason and Stan had envisioned all of this time – came to fruition, and was shown to the world. It offered a system in which you can easily talk to your friends, stay in touch with shared interests and communities, text, voice call, and video call over the internet. The aim was to create a hub where people can join, connect, and enjoy this system, and that was well and truly achieved from the get-go.



apc EDITOR'S CHOICE

To manage a team, keep your workspace organised, and chat with your mates in one place, turn to Slack.


Discord
Download
Nitro
Discover
Safety
Support
Blog
Careers
apc
HIGHLY RECOMMENDED
IMAGINE A PLACE...
where you can belong to a school club, a gaming group, or a worldwide art community.
Where just you and a handful of friends can spend time together. A place that makes it easy
to talk every day and hang out more often.
Download for Windows
Open Discord in your browser

If your priority is gaming when you're online with your friends, then Discord is more appropriate for the task.

Head to head

Fundamentally, both apps offer very similar features. Although both have fantastic, visually appealing user interfaces that provide a playful yet practical layout, Slack favours the more professional approach, while Discord has gaming at the forefront. So depending on what angle you're coming from, this might be your deciding factor. In terms of design, Slack was a slightly better experience. It has a more vibrant colour scheme which makes the interface easier, more efficient, and even quite fun. We preferred Slack's default lighter theme to Discord's default darker theme, though both can be changed if necessary.

Discord just looks noisier to us. The layout, however, was relatively similar. To the left of both landing pages are sidebars featuring icons of people you connect with via direct messages, channels, threads/servers, etc. The main section was the chat part of these elements, just expanded, with search bars at the top.

Let's turn our attention back to the features, which is where things start to take a turn. Both applications offer free and paid tiers, but Discord offers more value for its free membership. Most of Discord's features are available for free, while the same can't be said for Slack. Discord does support data retention, but Slack only supports it for 90 days with its free version, which is frustrating if you want to look through your chats. Also behind a paywall on Slack are certain voice call features, such as calling with more than one other participant, which again, causes frustration, as this is supposed to be a place for centralisation. If you want this, it'll cost a minimum of US$7.25 (technically US$3.62 for the first three months due to a discount).

Where Slack takes the upper hand again is productivity. It features elements called channels, where your work within a team happens, and can help keep track of your team and current projects. Shared channels can also be created to include members from external sources too.

Discord also features channels, but these work in a slightly different way. Communities are split up into servers. Within these, you have text and voice channels. The latter gives you options to connect via voice or video and to go live by sharing your screen (streaming). In the text channels, you can post messages, images, files, etc. Both Slack and Discord have direct messaging features with the same functionalities – these are snappy, easy to use, and work effectively. Slack's system is more intuitive than Discord's, and has a more business-led projection.

Your preference will depend on whether you want business or pleasure. If you are here for the prior then go with Slack – for pleasure, go with Discord.

Some areas where Slack tops Discord are file sharing, app integrations, text communication, and the interface. You can simply share larger files, as Google Drive is integrated. Other integrations include Zoom, Google Calendar, Google Sheets, Dropbox, OneDrive and SharePoint, Salesforce, and more.

In contrast, Discord beats Slack when it comes to audio and video calls. With an 8MB file sharing limit, compared to Slack's 1GB per file with its free package, it's not going to beat Slack in productivity, but for gaming, it's the winner. It's mainly the ease of use and being able to quickly change input and output settings that make Discord a better system for calling.

> "Your preference will depend on whether you want business or pleasure. If you are here for the prior then go with Slack – for pleasure, go with Discord."

However, if you have to choose one, Slack is a more well-rounded product, with a cleaner UI and better organisation so you can keep tabs on all of your workflow. It also still offers the ability to voice call. It's a very handy tool that we recommend you to keep, and despite needing the Pro package to get all of the necessary features from it, it's actually worth the monthly installments to keep your productivity and communication running smoothly.

Slack Organised UI, bold and colour ordered, the one app that does it all, though basic features such as group calls are behind paywalls.

★★★★½

Discord Fun, quirky design, the best gaming party chat application. Noisier layout and fewer productivity-based features.

Sam Lewis

★★★★☆

TECHNOTES

Gadgets

Delightful devices.

1 LG TONE FREE TF8

Fitness first buds with a big sound.

$369 | lg.com/au

LG's naming convention may make these wireless earbuds seem like they're incapable of mediating pitch, but these true-wireless buds are actually pretty great in terms of audio quality, especially for fitness focused headphones. A partnership with Meridian and Dolby means you can play spatial audio on these sporty buds and there's Active Noise Cancelling and ambient sound options to allow you to adapt to your workout surroundings. While the headphones have a novel SwivelGrip in ear bud and wing grip technology, all the in ear bud options were too large for us, so you'll need larger than average ear canals for these ones.

2 ROG ALLY

A gaming teammate that'll go anywhere with you.

$1,299 | rog.asus.com/au

The ROG Ally is a Windows 11 handheld gaming device that'll let you play all your favourite PC games anywhere. The powerful switch-like handheld offers 8.6 teraflops of GPU performance, which isn't quite the same as current consoles... but it's not far from it. This means you can expect titles like the optimised *Cyberpunk 2077* at 40fps-plus framerates when using default 1080p settings and the AMD FSR upscaling tech. This runs on a 7-inch, 16-by-9 FHD display with a 120Hz refresh rate, 7ms response time and 500 nit brightness, that's wedged between two controller handles. All up a great partner for any gaming battle.

3 NANOLEAF LIGHTSTRIP STARTER KIT (2M)

Smart home lighting that really Matters.

$89.99 | nanoleaf.me

Now offering a Matter compatible option, Nanoleaf's Lightstrip is an easy way to light up your space. Whether you want a light show in your kitchen or to set the mood in the bedroom, these light strips are easy to install and connect. To use all the features of Nanoleaf's latest light strips, you'll need a Thread border router such as a Google Nest Hub (2nd gen) or an Apple HomePod mini, but once you've got it set up in your home, it's super easy to set your lights to your chosen colours, as well as schedule on and off times to suit your needs.

❹

SEGWAY NINEBOT KICKSCOOTER MAX G2

Segway's got a new bigger and better electric scooter.

$1,699 | au.segway.com

The original personal EV company has released a new range of electric scooters to the Australian market with a bunch of novel features. The flagship Max G2 scooter offers a 70 km range and powerful motor that can utilise 900W of power to get up hills with a 22-percent incline. The $1,699 device is packed with advanced features like hydraulic suspension, anti-skid traction control and a full set of indicators. The 15,300mAh battery should be enough to last an entire week of commuting and the tubeless 10-inch tyres are puncture resistant and self healing, so a flat will never stop you from getting to work on time.

❺

OONI VOLT 12

Perfectly cooked pizza in your own kitchen.

$1,499 | ooni.com.au

Popular English pizza oven company Ooni has released its first electric pizza oven, allowing users to cook the perfect home-made pizza from the convenience of the kitchen. Most home pizza ovens use either LPG or wood fired fuels, which aren't ideal for indoor use, but his new electric offering plugs into a standard power outlet and heats up to 450-degrees in just 20 minutes – a temperature that allows you to cook a pizza in 90 seconds. Ooni have even made the device weather resistant for those times you do still want to cook outdoors.

❻

XGIMI MOGO 2 PRO

A colour corrected FHD portable projector with Dolby Audio.

US$599 | xgimi.com.au

The MoGo 2 Pro is is a portable DLP projector from XGIMI with 1080p resolution and 400 ISO Lumens that can throw a projection from 40 to 200-inches. It's not the brightest projector so you'll only be able to use it in really dark settings but it does come with the latest Android TV, Chromecast connectivity and Google assistant functionalities that'll make it easy to get all your favourite shows up and running in no time. The device comes with two 8w audio drivers that can deliver Dolby Audio sound and it's been calibrated to reach 90-percent of the DCI-P3 colour gamut, which should help movie colour accuracy.

LAPTOP

Asus ROG Zephyrus M16

Asus gives its best gaming Ultrabook a new processor and the awesome-looking Animatrix exterior lighting array.

■ $4,299 | rog.asus.com/au

■ W11 Pro; 16-inch Mini LED display at 2560 x 1600 pixel resolution, 240Hz refresh rate, 3ms response rate, DisplayHDR1000, G-Sync, 100% DCI-P3; Intel Core i9-13900H CPU; Nvidia GeForce RTX 4070 GPU; 32GB RAM; 1TB PCIe SSD; 90Wh battery (4h11min PCMark 10 Work); 35.5 x 24.6 x 2.2cm; 2.32kg.

The 2022 ROG Zephyrus M16 Ultraportable gaming laptop was so impressive that we gave it 4.5/5 stars back in APC 509. That laptop was well regarded by many, and perhaps that's part of the reason why Asus has decided to only release one new configuration in 2023 and sell it alongside last year's i7 units. The update is designed to sit at the top of the range with a 13th generation Intel Core i9 CPU and a Nvidia GeForce RTX 4070 GPU for $4,299.

Asus didn't actually send us this unit, but rather one that's only available in international markets with a beefy RTX 4090 GPU. Interestingly, rather than wow us with additional performance, this mix up mainly showed us that you really wouldn't want to fork out for that expensive GPU since this lightweight gaming Ultrabook has nowhere near enough cooling architecture to make the most of it. So we're definitely in agreement that the model with a 4070 GPU is a good upper limit to the ROG Zephyrus M16 2023.

At 2.3kg (for the 4090 unit) and 2.2cm thick, the ROG Zephyrus is thicker and heavier than the 2022 Razer Blade 15, but only fractionally. Part of this is likely to be from the M16's new Animatrix back panel, a 18,710 LED back panel that allows you to add customised animations to the exterior of your laptop. Sure it's not going to be why you spend $4k on a laptop, but it's an innovative and cool feature that means this gaming ultrabook can look professional or fun depending on what you're doing.

The Intel Core i9-13900H CPU on the M16 might have 14 cores and a boost clock speed of 5.4GHz, but it's not quite as powerful as the top processors you'll see on beefier gaming laptops. This means it can be 20 to 40 percent behind something running a Ryzen 9 7945HX or an Intel Core i9-13900HX. It's still capable of a meaningful 29 percent performance increase over the i9 m16 we tested last year in some benchmarks, but keep in mind that it's not going to be the same as a dedicated gaming laptop.

This was the same story with the 150W 4090 GPU that we tested offering around 25 percent lower frame rates than a ROG Strix Scar 17 with the same GPU – albeit with a higher 175W GPU thermal design power. We suspect that the 140W RTX 4070 models that are sold in Australia will likely only be 15 percent behind the real world framerates we saw on the unit we benchmarked, which translates to 100 fps-plus on current 1080p titles.

This performance matches the capabilities of the 16-inch 240Hz QHD-plus display well with enough power to drive high resolution or high refresh gaming. It also continues to meet the full DCI-P3 HDR colour gamut that allows professional video work using a Mini LED backlighting array that offers a 1100 nit peak brightness.

Battery life isn't amazing for an Ultrabook. Even when the energy saving MUX GPU switch and Nvidia Advanced Optimus are on, it only lasts just over four hours in light work tasks, but you do get 7.5 hours from 1080p movie playback, which is impressive for a gaming laptop.

	2023 Asus ROG Zephyrus M16	2022 Asus ROG Zephyrus M16
PCMark 10 - Overall (score)	6,996	7,208
Cinebench R23 - CPU (Score)	19,903	15,483
PCMark 10 - Battery Work (HH:MM)	4h11min	2h55min
3DMark Time Spy (score)	14,341	9,528
F1 2021 - 1080p Ultra (fps Av.)	161	95
Cyberpunk 2077 - QHD Ultra RT	29.00	DNT
CrystalDiskMark Read (MB/s)	7,102	7,089
CrystalDiskMark Write (MB/s)	5,279	5,285

A nice update to a popular gaming Ultrabook for great gaming on the go.

Joel Burgess

★★★★☆

LAPTOP

Acer Swift Go 16

Acer goes after the more affordable laptop market by offering a vibrant OLED display.

■ $1,799 | online.acer.com.au

Occasionally there is a major shift in technology that causes an entire overhaul of the types of laptops available for consumers... and in 2023 that means anyone buying a mid-range laptop can now get an impressive OLED screen without bumping up the price.

The Acer Swift Go 16 is the first out of the gate with a 16-inch Ultrabook offering a 3K OLED panel, a 13th Gen Intel i7 CPU and solid supporting specs for $500 to $1,000 less than anything we saw in the premium Ultrabook space last year. While those specs might seem a little unbelievable right now, we've scouted a few other premium ultrabooks on the horizon with OLED screens that will be sold for even less, so rest assured Acer's offering is the real-deal.

So the Swift Go range also comes in a 14-inch sizing available for as little as $999 when paired with a 14-inch 2.8K OLED display, i5-13500H CPU, 8GB RAM and 512GB SSD. The bigger 16-inch model starts at $1,529 for a device that offers a 16-inch 3.2K OLED 120Hz panel, i5-13500H CPU, 16GB of RAM and a 512GB SSD. The model we tested had the same 16-inch panel and CPU, 16GB of RAM and a 1TB SSD available for $1,799.

The screen is obviously the main drawcard here. It's brighter than you might expect from a budget OLED panel offering DisplayHDR 500 certification and a peak brightness of 500 nits, but it's also got amazing colour chops, hitting the full DCI-P3 colour gamut, making it suitable for professional video colour editing. Add to this a detailed 3200 by 2000 resolution and a silk smooth 120Hz refresh rate and we really can't fault anything about the screen... it's on par with devices you'd previously pay thousands more for.

Usually having a drawcard like that on a budget device would impact other areas, but the Swift Go 16 has a new Intel Core i7-13700H CPU that outpaces Apple's M1 and M2 processors on the Macbook Airs by between 30 and 50 percent. Last year's 12th gen H series of laptop CPUs were used by gaming Ultrabooks and other powerful creative devices that offer better cooling and higher power allocations, which ended up with similar performance to this unit. So the i7-13700H is probably excessive here and leaves the door open for laptops with lower specced CPUs to offer bigger discounts with similar performance, but when the device is priced so affordably it's hard to criticise it for this without competitors to point to.

The integrated Intel Iris Xe is about 30-percent behind Apple's M2 10-core GPU, but it's ahead of the M1 and en-par with the top 12th gen integrated Intel GPUs. Battery life could be better, lasting around 5.5 hours for both work tasks and media playback, but it's workable for those happy to carry a charger. The keyboard is crisp and the trackpad is responsive. The audio projects from the top of the keyboard and misses some of the spatial audio qualities you'll get on more expensive devices, and the bezel is fractionally thicker than top units, but these are all minor concessions considering the price.

■ W11 Home; 16-inch 120Hz OLED display at 3200 x 2000 pixel resolution; 500 nit peak brightness, . DisplayHDR 500 True Black, 100% DCI-P3; Intel COre i7-13700H CPU; Intel Iris Xe GPU; 16GB RAM; 1TB WD PCIe SSD; 65Wh battery (5h24min 1080p movie playback); 31.3 x 21.2 x 1.5cm; 1.6kg.

	Acer Swift Go 16	Apple MacBook Air (M2) Mid-2022
Cinebench R23 - CPU (single-core)	13,722	1,599
Cinebench R23 - CPU (multi-threaded)	1,882	8481
Geekbench 5 - Multi-core (score)	11,222	8,896
Geekbench 5 - OpenCL (score)	20,863	27,637
Sid Meier's Civilization VI - 1080p, Ultra (fps)	26	41
Battery life - 1080p video playback (h:min)	05:24	19:05
Blackmagic Disk Speed Read (MB/s)	5,261	3,063
Blackmagic Disk Speed Write (MB/s)	4,943	2,873

A powerful, portable OLED Ultrabook at mid-range laptop prices

Joel Burgess

★★★★½

LAPTOP

Asus ROG Strix Scar 18

Asus leads the wave of new gigantic gaming laptops, but will it be a big hit or just a blowout?

■ $7,499 | rog.asus.com/au

It's been a while since gaming laptop vendors really pushed their most monstrous rigs, but it seems 2023 is keen to unleash a new breed of 18-inch gaming workstations onto the local market. Asus is first cab off the rank here but you'll see plenty more in subsequent pages of *APC* since just about every gaming laptop vendor has built an 18-incher this season. And why not? When you consider the ROG Strix Scar 18 can be configured with Intel's top of the line Core i9-13980HX CPU, 32GB of RAM and the most powerful Nvidia GeForce RTX 4090 GPU with a 175W power allocation, that's a solid array of expensive components to make a margin on.

The Scar 18 described above retails for $7,499, an unapproachable price point for the vast majority of gaming laptop buyers, but this lofty price tag doesn't seem unreasonable at face value.

That said, when you're looking at the Scar 18 it's going to be impossible to avoid making comparisons between that and the Asus ROG Strix Scar 17 that we looked at in the last issue (*APC* 520) – a device that offers an almost identical set of components with a 0.7-inch smaller 17.3-inch display and an AMD CPU that sells for close to $2k less at $5,599. What's perhaps more surprising is that the less-expensive Scar 17 with an AMD Ryzen 9 7945HX offers up to 13-percent better CPU performance in some tasks and virtually identical real-world gaming performance.

One area that the Scar 18 does outperform the Scar 17 is in battery life, lasting between nine and 20-percent longer – an achievement that isn't all that impressive when you factor in that it equates to a maximum of three hours and 44 minutes total lifespan for light work tasks. Still this isn't terrible for a gaming laptop and when it comes to games it has a lot going for it.

■ W11 Home; 18-inch IPS display at 2560 x 1600 pixel resolution, 240Hz refresh rate, 3ms response rate, 100% DCI-P3, G-Sync Certified, Intel Core i9-13980HX CPU; NvidiaGeForce RTX 4090 (175W) GPU; 32GB RAM; 2 x 1TB M.2 SSDs in RAID 0; 90Wh battery (3h15min 1080p movie playback); 39.9 x 29.4 x 3.1cm; 3.1kg.

You can expect to play any 1080p game at Ultra settings with framerates over 130 fps, which means you can make use of the 240Hz refresh rate, G-sync certification and a 3ms response rate on the 18-inch IPS display. For those moments when you're not gaming against others, bumping the resolution to QHD+ and engaging HDR on the Pantone Certified screen will make games look excellent at a silky-smooth 85 fps.

The one potential novel element of the Strix Scar 18 is the inclusion of two PCIe 4.0 NVMe M.2 SSDs that are configured in striped formatting for read and write speeds theoretically twice as fast as anything we've seen, but the model we were sent unfortunately didn't include this feature.

At 3.1kg you're not going to want to be carrying it around all day, but it's perfectly portable for a workstation with this much power. So other than the price and the potential for offering better 4K or OLED display technology there's nothing really wrong here, but there's better value offerings around for the more standard 17.3-inch form factor.

	Asus ROG Strix Scar G18 (2023)	Asus ROG Strix Scar 17 (2023)
PCMark 10 - Overall (score)	7,478	8,502
Cinebench R23 - CPU (Score)	28,418	32,646
PCMark 10 - Battery Work (HH:MM)	03:44	03:25
3DMark Time Spy (score)	20,116	18,078
F1 2021 - 1080p Ultra (fps Av.)	206	191
Cyberpunk 2077 - QHD Ultra RT	85 (QHD)	87.91(QHD)
CrystalDiskMark Read(MB/s)	7,108	7,381
CrystalDiskMark Write (MB/s)	5,275	6,511

A gaming powerhouse in a new expensive 18-inch form factor.

Joel Burgess

★★★½☆

PROJECTOR

XGIMI Horizon Pro 4K Projector

The best alternative to a TV?

■ $4,799 | au.xgimi.com

apc
EDITOR'S CHOICE
"This projector uses the Android TV OS, meaning that the UI is fluid and there are plenty of options to customise your experience without having to connect any other external devices to the Horizon Pro."

If you're paying just shy of $5,000 for a projector, then it's probably desirable that it meets certain criteria. The chances are you're buying one to increase the size of your screen so, of course, it has to have a large projection size. The quality also has to impress, otherwise, the novelty soon wears thin, and it has to be easy to use. If these three criteria are met, then you should be halfway there to an immersive cinema experience that improves upon a conventional TV.

Ideally, your new projector should also have all the functionality of a smart TV with alternative connectivity options for a game console or a PC, for example. XGIMI is no stranger to the world of projectors and this Horizon Pro 4K model is one of the top offerings in its range. So, can this media masterpiece conquer all and be your next projector?

As with other XGIMI projectors, the Horizon Pro offers great keystone and autofocusing software capabilities. This eliminates one of the most common problems when using a projector, the setup process. The auto-keystone correction setting means you can offset your projector and still get a straight and clean image on your wall. You can further fine-tune this with the manual adjustment option. There are also choices for auto-obstacle avoidance, auto-screen alignment, auto-keystone upon motion or startup, and an image zoom function.

■ Projector type: DLP; Native resolution: 4K 3840 x 2160; Refresh rate: 60Hz; Brightness: 2,200 ANSI Lumens; Projection size up to 200 inches; Lamp life: 30,000 hours; Connectivity: WiFi Dual-band 2.4/5GHz, Bluetooth 5.0; Ports: HDMI 2.0, HDMI (EARC Supported), 2x USB 2.0, Type-A, LAN, 3.5mm aux, Optical, DC in.

This projector uses the Android TV OS, meaning that the UI is fluid and there are plenty of options to customise your experience without having to connect any other external devices to the Horizon Pro. There are plenty of services available out of the box, including built-in Chromecast, Google Play Store, and Google Assistant, so you can get most of what you need here. However, if you want to connect externally, there are two HDMI ports, two USB ports, and an Optical and 3.5mm port so you can connect a different speaker setup. Saying that, the built-in Harmon Kardon speakers do a perfectly good job of delivering a warm and loud solution for a typical living room environment, much like a decent, high-end TV would.

Not only can this projector cast a display of up to 200-inches in size, it does so with impressive picture quality, boasting a 4K resolution that holds up well, right up to that 200-inch maximum. The detail is crisp at all times, especially with the ability to autofocus straight from the included remote to quickly get your picture correct. In the settings, you can choose between many presets and alter your colour setup. Thanks to a rating of 2,200 ANSI lumens, brightness is good enough for all-day viewing, which can be an issue with some projectors. Great colour accuracy and contrast make this display a joy to use and experience. While the 1080p Full HD models provide admirable image quality, this 4K model takes things up a gear and in terms of longevity, is the better option.

The kicker here is that it's an expensive product. Sure, it provides stunning visuals and great brightness and has an abundance of features to make the process easy and enjoyable but it will empty your wallet. However, if you're looking for a projector that can replace your TV, you won't go wrong with the XGIMI Horizon Pro 4K.

Fantastic premium feel with gorgeous picture quality and Android TV built-in plus a rich sound stage.

Sam Lewis

★★★★½

SMARTPHONE

Google Pixel 7a

More expensive than its predecessor but also a huge improvement.

■ $749 | store.google.com

The Google Pixel 7a is not your usual budget phone. Rather than cutting features from the Pixel 7 to keep the price low, Google has packed in as many capabilities as possible, to the point where there isn't a huge difference between the Pixel 7a and the fully featured original.

Even the launch price is the same. Where last year's Pixel 6a came in at a tempting $749, the 7a launches at exactly the same price. It's not a huge leap, but it's a harder sell: the regular Pixel 7 can be found online for around that same price, too. The old 6a is still on sale too, now at a knockdown $599.

Double down

The Pixel 7a keeps the distinctive Pixel 7 design, with a horizontal camera bar sticking out across the back panel. You may or may not like the way it looks, but it means the phone doesn't wobble on flat surfaces. There's a choice of Charcoal, Snow and Sea finishes, plus an extra Coral (orange) option only available if you buy direct from the Google Store.

While the Pixel 7a looks sharp, you can tell it's been built to a budget. There's more plastic around the frame than on the Pixel 7, and you get Gorilla Glass 3 on the screen instead of the more durable Gorilla Glass Victus. The phone is also slightly less water-resistant than the Pixel 7, with an IP67 rating rather than IP68, which means it should still survive a dunk in up to 1m of water.

Still, there's good news when you turn to the screen. While previous a-series Pixel phones have been stuck at 60Hz, the Pixel 7a matches the 90Hz refresh rate of the Pixel 7. It's bright, too: I measured a maximum of 931cd/m2 with HDR brightness turned on, again on par with the Pixel 7.

The panels aren't identical, however. The 7a has a smaller 6.1in display, and the bezel is more noticeable by comparison. Colours aren't quite as vibrant, either: videos just didn't pop the way they do on other smartphone screens.

The Pixel 7a has the same camera bar sticking out at the back as the Pixel 7.

■ 8-core Google Tensor G2 processor ; 8GB RAM; Mali-G710 graphics; 6.1in 90Hz AMOLED screen, 1,080 x 2,400 resolution; 5G; 128GB storage; IP67 rating; dual 64MP/13MP rear cameras; 13MP front camera; Wi-Fi 6E; Bluetooth 5.3; NFC; 4,385mAh battery; USB-C connector; Android 13; 73 x 9 x 152mm (WDH); 194g; 1yr warranty.

Still, colour range and accuracy are good for what is still nominally a low-cost phone. The Pixel 7a covers 112 percent and 79 percent of the sRGB and DCI-P3 colour spaces in Natural mode, and if you switch to Vivid mode those percentages increase to 130 percent and 90 percent respectively. And a Delta E of 0.11 in Natural mode is outstanding.

One last point to note is that the 7a features an under-display fingerprint sensor, but I found it hit-and-miss; happily, however, Google has added Face Unlock to the 7a.

Photo power

Photography has always been a big selling point of Pixel phones, and the 7a benefits not only from Google's AI-powered photo processing, but a new 64MP main sensor. It's smaller than the one on the Pixel 7 – measuring 1/1.73in versus 1/1.31in – but it produced great results, with deep colours and strong contrast.

Its one quirk is that it favours darker exposures. This can create impressively solid-looking results, especially in low light, but it doesn't always work to the Pixel 7a's advantage. A photo I took of rows of differently coloured peppers at a supermarket came out with an unwanted emphasis on the shadows; when I took a portrait of a colleague, the Pixel 7a's dark tone masked the details of his face. Overall I preferred the lighter, livelier results I got from shooting the same scenes on an iPhone SE or Samsung Galaxy A54.

Another thing that's new with the Pixel 7a is the super-res zoom feature, which uses AI to add clarity and detail to zoomed-in shots. It works well with the Pixel 7a's all-digital zoom: at 2x magnification you'd struggle to tell the difference between this and a real telephoto lens. Even at the maximum 8x magnification I captured some impressively crisp-looking skyline shots, although if you look more closely you'll notice a lack of fine detail.

The Pixel 7a also supports 4K video capture at 30 frames per second on all cameras – another first for an a-series phone. I was

Above: The new 64MP sensor produces great results, with strong colours and contrast.
Right: The 90Hz refresh rate helps games play smoothly.

impressed by the results, which were bright, clear and well stabilised.

Pure power

The Google Pixel 7a uses the same Tensor G2 chipset as the Pixel 7, and comes with the same 8GB of RAM. In Geekbench 5 the Pixel 7a achieved single-core and multicore results of 1,018 and 3,065 respectively, almost matching the 1,054 and 3,021 we saw from the Pixel 7.

This means the 7a easily beats the Samsung Galaxy A54, which scored 781 and 2,664 in the same tests. Similarly, in the 3DMark Wild Life Unlimited graphics test the Pixel 7a churned out 41fps, a fraction ahead of the Pixel 7's 40fps tally, while the Galaxy A54 trailed with 17fps.

None of these phones can keep up with Apple's home-grown processors: the iPhone SE rode its A15 Bionic processor to a multicore Geekbench score of 4,482, and 50fps in the 3DMark test. But the Pixel 7a handled any app I threw at it, including demanding games such as *PUBG Mobile*.

Battery bonanza

Battery life hasn't been a strength of previous a-series Pixel phones. The Pixel 6a petered out after less than six-and-a-half hours of 5G web browsing – more than three hours behind the average smartphone. And I was concerned to note that the Pixel 7a's battery is no bigger, with a capacity of 4,385mAh to the Pixel 6a's 4,410mAh cell.

I needn't have worried: either Google has built better power management features into its Tensor chipset, or it's figured out some very effective software optimisations. Either way, the Pixel 7a averaged a much-improved 10hrs 5mins in that test, making it officially above average when it comes to battery life. Note that these tests were run with the screen set to 60Hz: the faster 90Hz mode may eat up the power a little more quickly.

There's a pleasant surprise on the charging front, too. Unlike the 6a, the Pixel 7a supports wireless charging – not something you tend to find on budget phones. 18W wired charging proved enough to get me from zero to 43 percent in half an hour.

Special skills

I've mentioned that the Tensor G2 chip inside the Pixel 7a is the same as the one on the Pixel 7 and Pixel 7 Pro, and that means the 7a can do all the same machine-learning tricks as Google's pricier phones. That includes photo-editing features such as Magic Eraser for removing unwanted objects from photos, and Photo Unblur, which uses AI to clean up blurry faces in your photos. The photos don't even have to be shot with this phone.

But Tensor's tricks don't only apply to photos. You can get transcriptions of voice messages in the Messages app, or dictate your own messages with Assistant Voice Typing. Quick phrases let you control timers or handle incoming calls using your voice, without having to say "OK Google" first. And the Clear Calling feature helps eliminate background noise from phone calls.

One of my favourite Tensor-enabled features is Speaker Labels in the Recorder app. This could already generate impressively accurate transcripts of your voice memos; now it can also indicate precisely who said what. It's fantastic for meetings.

So, there's plenty to like about the Pixel 7a. Google's previous mid-price phones have felt palpably cut down, but the 7a rewrites our expectations of a mid-price Pixel. In fact, it's hard to see why you'd pay extra for the original phone at this point. The Pixel 7 does have a better camera sensor and a more solid build, but the day-to-day user experience is almost identical across the two phones – even down to the Pixel-exclusive goodies. It's more expensive than last year's model, but unless you need the optical zoom that only the Pixel 7 Pro offers, the Pixel 7a is the Google phone you should buy.

The new smart choice in Google-brand phones.

Philip Michaels

★★★★★

The Pixel 7a comes in a choice of four colourways, with Coral only sold online.

ROUTER

MSI RadiX AX6600

MSI has spent years building this: its first premium gaming router.

■ $449 | au.msi.com

■ Speed: Wi-Fi6 6,600Mbps | Connectivity: 3 x Gigabit Ethernet LAN, 1 x Gigabit Ethernet WAN/LAN, 1 x 2.5Gbps WAN/LAN, USB-A 3.0 | Features: 1.8GHz quad-Core CPU, parental controls, AI QoS optimisation, Alexa and Google Assistant compatible.

Player 2 has entered the game. And, thank goodness. For the past year Asus has been competing with itself to create increasingly bonkers gaming routers with no real challenger. Now, here's MSI with its rival raddish, erm, RadiX, which it's apparently been perfecting for the past three years. Clearly, it's the Taiwanese Wi-Fi equivalent of Ford versus Ferrari. Pilotes, démarrez vos routeurs!

First up is the design. The RadiX's high-quality, plastic livery evokes that of MSI's epic Raider gaming laptops, with its gun-metal grey chassis and embossed, silver dragon logo... but without all the RGB. Inside, there's a laptop-honed heat-pipe array to alleviate thermal throttling and keep everything cool under load.

At the rear is a 2.5Gbps WAN/LAN port, a Gigabit WAN/LAN port, three Gigabit LAN ports and a USB 3.0 port. On the top are three buttons which activate LED status lights, WPS connect and Wi-Fi.

Set-up is simple thanks to the well-polished app and QR code combo.

Performance comes via six antennae operating across one 2.4GHz and two 5GHz bands for a maximum theoretical throughput of 6,600Mbps. We're a little disappointed not to see Wi-Fi 6E supported – especially as MSI's laptops were the first to implement it – but we've not been impressed by the 6E implementations we've seen so far.

In our tests (in our Sydney weatherboard cottage) it downloaded large video files from our Ethernet-connected NAS to our Dell XPS 15 laptop at 798Mbps up close, 476Mbps (two rooms away) and 235.5Mbps 15m away at the end of our garden. We've seen higher scores from Asus' monsters at close-range and from mesh systems at distance, but the fact MSI finished close behind the leaders in every test, makes it the overall performance winner!

Still, it took years for Asus' routers' apps to go from half-baked thought bubbles to reliable tools, so we were curious about MSI's first attempt. The phone app's screen first displays QoS modes for Gaming, Streaming, WFH, plus Manual or AI. Unfortunately, it took several minutes to switch between them, so we left it on AI. There's also information regarding internet, devices and network resource usage. The Game Center screen repeats the gaming QoS and manual options but without the hanging.

The final 'Settings' tab has everything else, which includes basic network monitoring tools and parental controls. The latter offers content filtering for Apps and web content (which is always fallible) plus the ability to set access schedules for devices. While it's basic compared to other offerings, it's free and has the important options. The Desktop firmware offers the usual Port Forwarding, VPN and Guest Network features plus some useful USB-port-oriented media server and Bittorrent client features. It's (mostly) polished and responsive and all the important features are there.

At $449, the MSI Radix dramatically undercuts Asus' rivals. It even represents an attractive, gaming-oriented alternative to Synology's outstanding, feature-laden rivals. It might not possess every feature available on the market, but the consistent, high-level performance and value on offer mean the Radix might not have won the individual gaming-router race, but it's won the championship.

Brilliant all-round performance and an attractive price make the RadiX a winner.

Nick Ross

★★★★★

CASE

Thermaltake CTE C750 Air

A good looker where airflow and thermals are paramount.

■ $269 | thermaltake.com.au

The Thermaltake CTE C750 Air is a member of Thermaltake's new CTE case family. CTE stands for Centralized Thermal Efficiency. The idea is to position the hottest components more towards the center of the chassis where they will benefit from the best possible airflow. It's a sound theory.

But shifting the motherboard placement a little isn't the highlight of this case. Its flexibility is. While not a new concept, the CTE C750 is designed to house a 90 degree rotated motherboard, meaning the I/O and GPU outputs are at the top of the chassis. Add that to that a huge range of possible fan and radiator placement options and it is something refreshingly different.

Here for review I have The CTE C750 Air version. It doesn't come with ARGB fans, unlike its slightly more expensive and aptly named CTE C750 ARGB sibling. It's a very big case but at $269 it's good value for money for such a large and flexible offering.

The CTE C750 is available in black or white versions. I received the black version for review. At nearly 600mm tall, it's already big, but its 327mm wide too, making it a truly big boy. The front I/O is worthy of praise. You get one USB 3.2 Gen 2 Type-C port, four USB 3.0 ports and a HD Audio jack joining the usual power and reset buttons.

A big case like this means you get a vast amount of space inside. That'll be welcome for builders looking for a lot of space for tubing. It can house up to fourteen fans and radiators in five different locations.

One of my favorite features is the sheer amount of space behind the motherboard tray. This makes cable management a breeze, leaving plenty of space for thick and stiff PSU cables. However, some thought needs to go into your fan installation as it can be difficult to route fan and RGB cables for a rotated motherboard, at least it is if you're a fussy builder. Your cables might need to go to headers in locations you might not expect.

Thermaltake's choice to include just three fans is a wise one in my opinion. It helps to keep the cost down, and as this is a case designed for high end systems and watercooling, the chances are you'll deck it out with your choice of fans anyway, possibly leaving the bundled Thermaltake ones as superfluous extras.

But it isn't perfect. Access to the motherboard's rear I/O is impossible without taking off the top panel and air filter. I also don't like the thin gap TT left for routing cables. Some cables simply won't fit.

I'd also like to see a small modification or two to assist with routing ARGB and fan cables. They can end up like spaghetti if you don't take care to route them properly.

The C750 is a welcome attempt by Thermaltake to innovate in the PC case market. With just a couple of tweaks, the C750 could go from being good to great. It's a unique case that offers flexibility and good value for money even if it's best suited to the most powerful builds with expansive water cooling systems.

"A big case like this means you get a vast amount of space inside. That'll be welcome for builders looking for a lot of space for tubing. It can house up to fourteen fans and radiators in five different locations."

Big and a delight to build in, with some clever design innovation.

Chris Szewczyk

★★★★☆

GRAPHICS CARD

AMD Radeon RX 7600

Does just enough to shake up the entry level gaming GPU market.

■ $459 | amd.com

Following the release of AMD's Radeon RX 7900 XT and RX 7900 XTX, you might have expected AMD to follow a traditional release cadence and produce an RX 7800 or RX 7700-series card next. Not this time around. Surprisingly, the second desktop RDNA 3 GPU to be released is the RX 7600.

After years of massively inflated GPU pricing, is the RX 7600 the card the market has been crying out for? At $459, the RX 7600 is easily the cheapest of the current generation of GPUs from either AMD or Nvidia though it's important not to overlook Intel's Arc cards either, at least from a value perspective. Nvidia is set to respond with the pricier RTX 4060 in July, so for now, the RX 7600 is touted as being a solid option if you're after a card on a tight budget.

AMD promotes the RX 7600 as a card for mainstream 1080p gamers. Its purpose is to bring competitive performance plus the latest tech and features down to an affordable price point. But don't go expecting wonders from the RX 7600. It's not a magical card that will compete with the top cards of the Radeon RX 6000-series. It's nowhere near. It's best described as an affordable upgrade for mid-tier GPUs of yesteryear. Think cards like the RX 580 or GTX 1060 and you'd be on the right track.

"AMD promotes the RX 7600 as a card for mainstream 1080p gamers. Its purpose is to bring competitive performance plus the latest tech and features down to an affordable price point."

But it's not like RX 6000 or RTX 30-series cards have disappeared. If you have something like an RTX 3060 Ti or RX 6600 XT or better, they are still very capable performers. Current generation options are more limited. The Nvidia RTX 4060 Ti costs a lot more, while on the AMD side, there's a gaping hole in the RX 7000 lineup all the way to the RX 7900 XT.

Then there's the elephant in the room. AMD did miss a trick by sticking with 8GB of VRAM. It's enough for 1080p in almost every current game, but can we say that two years from now? What if *Grand Theft Auto 6* turns out to be a VRAM hogging monster? 192-bit and 12GB of VRAM would have given the card more appeal and a longer life. We're seeing popular cards like the GTX 1060 and RTX 2060 6GB running into limits now, and there's no reason to expect the RX 7600 won't hit similar limits in a couple of years' time, if not sooner.

There are things I love about the card. It's got a good media engine that includes AV1 encode and decode support up to 8K, DisplayPort 2.1 and support for up to four simultaneous 4K displays at 144Hz each. That makes it a very capable HTPC or productivity GPU. There's nothing available (yet) at its price point that ticks all of those boxes.

AMD's choice to release the RX 7600 now seems a little odd. Is AMD running out of RX 6000-series cards? Will we ever see the likes of an RX 7800 or RX 7700? I'd love to be a fly on the wall when the product managers were having their meetings.

		AMD Radeon RX 7600	AMD Radeon RX 6600 XT	Nvidia RTX 3060 Ti
Total War: Warhammer III - 1920x1080 Ultra Preset	Min	62	54	72
	Avg	81	69	97
F1 2022 - 1920x1080 Ultra High Preset	Min	55	45	64
	Avg	60	50	70
Far Cry 6 - 1920x1080 Ultra Preset	Min	86	62	95
	Avg	96	72	105
Metro: Exodus Enhanced Edition - 1920x1080 Extreme Preset	Min	43.0	37.0	46.0
	Avg	66.0	56.0	77.0
Temperatures (C)	Full system power (w)	201	197	239
	Peak load	72	73	71
3DMark - Time Spy Extreme		5,361	4,640	6,109

It doesn't do enough to excite, and it faces tough competition from all sides.

Chris Szewczyk

★★★☆☆

GAMING MONITOR

AOC Gaming 24G2SP

High-refresh, low-latency gaming on a budget.

■ $239 | aoc.com

apc
HIGHLY RECOMMENDED
"As is the norm for gaming monitors, even at this end of the market, AOC has gone for IPS panel tech. That helps with achieving the low response times, but also bodes well for colour accuracy."

Carving out a niche in the busy monitor market isn't easy, but AOC has managed it better than most. A decade ago, it was a maker of utterly anonymous low-cost flat screens for office workers. Now, it's one of the most prolific gaming monitor brands in the business with screens to suit all budgets.

In that context, the new AOC Gaming 24G2SP combines AOC's hard-won gaming rep with its origins as a value-orientated outfit. This is a 24-inch 1080p panel, which is pretty modest by today's standards. But it offers a fair few gaming niceties, including 165Hz refresh, 1ms claimed response, and variable refresh rate.

As is the norm for gaming monitors, even at this end of the market, AOC has gone for IPS panel tech. That helps with achieving the low response times, but also bodes well for colour accuracy. It's less of an advantage for contrast performance and black levels. Indeed, AOC doesn't bother with any HDR pretence – there's not even token HDR400 or HDR10 support. This is purely an SDR panel.

To be frank, we're fine with that. Very few so-called HDR panels based on LCD technology deliver something approaching true HDR experience.

■ Panel size: 24-inch; Panel type: IPS; Resolution: 1920 x 1080; Refresh rate: 165Hz; Brightness: 300nits; Contrast: 1000:1; Inputs: 1x DisplayPort 1.2, 2x HDMI 1.4.

Those that do, namely mini-LED monitors with full array local dimming, not only cost a fortune, they come with all kinds of compromises that undermine the overall image quality.

Anyway, AOC rates the AOC Gaming 24G2SP at 300 nits for brightness, which is reasonable for an SDR monitor, while contrast is rated at 1,000:1, which again is par for the IPS course. As for inputs, you get a single DisplayPort 1.2 socket and a pair of HDMI 1.4 ports. The latter two only run to 144Hz refresh rather than 165Hz, which is limited to the DisplayPort connection.

On the ergonomics side, the stand adjusts for height, tilt, and swivel. This is an all-plastic affair, though reasonably well built given the modest price. Our only quibble with the design is that the icons moulded into the chin that denote the OSD control buttons are pretty much invisible, making settings changes more of a pain than they really ought to be.

Speaking of the OSD, AOC's layout is fairly comprehensive, if dated. Perhaps the most significant option involves the three levels of pixel overdrive. For once, the fastest setting is actually usable, delivering nippy pixel response with barely, if any, visible overshoot.

Running at the full 165Hz refresh, latency is very well suppressed, too. For overall speed, then, this is an extremely responsive display. It's probably not quite pro-level esports material, but for most, it will allow competitive performance in the usual online shooters.

If you're looking for something super speedy but still affordable, and very much predominantly if not exclusively for gaming, then the AOC Gaming 24G2SP is a great choice. But for an all-round compromise between gaming and other computing duties, we'd be inclined to up the budget just a bit for something like the Pixio PXC277 Advanced, also reviewed this month, which ups the ante to 27 inches and 1440p.

Zippy response with low latency, and it's nicely calibrated, though there's no HDR support.

Jeremy Laird

★★★★☆

MEMORY

G.Skill Trident Z5 RGB DDR5-7200 2x24GB

The first non-binary DDR5 kit to hit the APC Labs.

■ $545 | g.skill.com

DDR5 memory is getting faster just about every week. Back at the time of the launch, DDR5-6400 was about as good as it got, then came 6800 and 7600 and now the best kits are hitting 8000MHz with more to come.

But one thing that's always been the case with memory is it's been binary. With the introduction of DDR5, non-binary memory is hitting the market. So what the heck is it?

Memory capacity traditionally comes in powers of two, hence the 'binary' capacities. In 2023, you'll see most consumer RAM modules come in 8GB, 16GB, and 32GB capacities. In a dual channel kit, a typical 2x 16GB DDR5 kit gives you 32GB of memory. That's enough for a typical gaming system. The next jump from there is to a 64GB (2x 32GB) kit, which is an overly large increase in capacity and cost. Wouldn't it be nice to get something in between? Well, now you can.

Enter non-binary DDR5. Instead of 16GB or 32GB modules, we now have 24GB modules, or 48GB kits. That's a welcome middle ground. But there are also 48GB modules on the market too. That means a consumer level motherboard could have up to 4x 48GB (or 192GB) of DDR5 memory in just four slots. There's another nail in the coffin of DDR4.

You can always rely on G.Skill to push the envelope and it does so again with crazy speeds of DDR5-8000 and beyond. I have a slightly worldlier 2x 24GB 7200MHz kit on hand. It looks great, and it's fast on paper, but is it worth your hard-earned money?

The G.Skill Trident Z5 2x 24GB DDR5-7200 kit comes with 36-46-46-115 timings. I reviewed a 2x 16GB 7200MHz Trident Z5 kit, and its timings were a smidgen tighter at 34-45-45-115.

Perhaps the most surprising aspect of the kit is its price. If you had told me in November 2022 that you could get a 48GB 7200MHz kit for $545 I would have laughed at you. It's still not cheap, but I think it's a perfectly reasonable premium for a kit with 50 percent more capacity that's brand new to the market.

"Instead of 16GB or 32GB modules, we now have 24GB modules, or 48GB kits. That's a welcome middle ground. But there are also 48GB modules on the market too."

		G.Skill Trident Z5 DDR5-7200 2x24GB C36	G.Skill Trident Z5 DDR5-7200 2x16GB C34	Kingston Fury Beast DDR5-6000 2x16GB C36	Crucial DDR5-5600 2x16GB C45	Corsair Vengeance DDR5-4800 C40
Cinebench R23	Multi-thread index score	40,259	40,237	40,186	40,111	40,278
	Single-thread index score	2,279	2,284	2,277	2,281	2,282
Handbrake 1.5.1	FPS	93.8	94.6	93.3	92.7	89.11
7Zip 22.01	Billion instructions per second	209.12	212.20	203.92	193.27	188.12
AIDA64	Read	104,650	108,450	94,704	87,047	76,264
	Write	90,040	93,649	83,957	77,555	68,889

When it comes to gaming, then, my DDR5 buying advice remains the same. Only buy high spec DDR5 if you've got an equally high spec system to match. A mid-range system with top spec RAM won't benefit as much as it would by spending money on a faster CPU or GPU. They'll both give you more tangible performance improvements.

If you've got the rig to match, and money to spend, go for it!

Chris Szewczyk

★★★★☆

GAMING HEADSET

HYPERX CLOUD III

Stellar sound for slim budgets.

■ $159 | hyperx.com

Eight years is a long time between numbered Cloud verisons, but that's just testament to just how good a headset it is. If it aint broke and all that. The Cloud III takes an already great headset and tunes it up a notch further.

Taking the general tour of the Cloud III is pretty quick. It's pretty barebones, boasting what you really *need* without any of the faff. There's a volume scroll on the right side cup, while the left houses the cable socket, detachable noise-cancelling mic plus a handy mic mute button. The addition of a mute LED on the boom mic itself is a great QoL improvement.

The overall design is largely the same as the previous gen headset but with some minor tweaking. The steel frame and classic aluminium forks have seen a redesign, plus there's a bump in material quality across the whole unit. The end result is a bombproof headset that weighs under 300g and is ultracomfortable on the dome for marathon sessions.

Getting set up is a snap. The Cloud III is both mobile device and console friendly via its 3.5mm cable and over on the PC you jack in via an additional USB C/A adapter cable. It's a neat set up. Not only does it essentially double the length of the cable, but also easily manage the transition from PC to mobile or even to commuting if you're a one headset for everything kind of gamer.

Sonically, the Cloud III punch well above what their modest price tag might suggest. The 53mm angled drivers sound great through the range, though did weaken some in the upper treble. Pretty much a classic gaming headphone experience. PC users rejoice as the spatial audio with DTS:X enabled is fantastic.

This'll do us for maybe another eight years 'till the Cloud IV launch.

Dollar-for-dollar the best afforable gaming headset we've looked at for some time.

Troy Coleman

★★★★½

KEYBOARD

RAZER BLACKWIDOW V4 PRO

So I heard you like macros...

■ $399 | razer.com

Compared to the earlier BlackWidow V3 Pro, this latest update tweaks the media controls, repositions the control dial, and adds a fistful of macro buttons. You also get RGB illumination underneath both the keyboard and the included wrist rest, because apparently BlackWidow keyboards weren't shiny enough already.

There are only two switch options: Razer's clicky greens or linear yellows. Our review unit came with yellows, and while they weren't awful, they felt a little heavy in use. Whichever you pick, they come with pre-lubed stabilisers and two layers of dampening foam, although there's no hot swap option. As you'd expect from Razer, the plastic and aluminium construction exudes premium quality. Yet for such a chonker of a keyboard, it is impressively lightweight.

> "As you'd expect from Razer, the plastic and aluminium construction exudes premium quality. Yet for such a chonker of a keyboard, it is impressively lightweight."

Where the BlackWidow V3 Pro had three media control buttons and a dial in the top-right, the V4 Pro ups that to four buttons and moves the dial to the top-left corner, replacing it with a volume roller. The dial lets you cycle through a range of commands, from vertical scrolling to alt tabbing. These can be enabled or disabled from Synapse, and the RGB glow under the dial changes colour depending on the function you've chosen. It's a clever, well-thought-out feature.

It's not just the macro keys that are customizable – you can remap every button and dial, from the volume roller to Y. While you might not feel the need to alter every single key on the device, that level of flexibility is appreciated.

There's no doubt that the BlackWidow V4 Pro is stacked to the gills with features. If you're after a premium keyboard built for macro lovers, it should be on your radar.

Stuffed with clever extras and a super-comfy wrist rest.

Alex Blake

★★★★☆

Windows 10 or 11 | www.pdfgear.com

PDFGEAR 1.0.14

PDF tool

There are plenty of ways to view and edit PDFs, including desktop software, online tools and options built into your browser, so you may question the need for another one. But PDFgear is the most impressive PDF program we've seen for a long time, not least because it's completely free – with no features locked behind Upgrade buttons. This updated version adds an AI-powered chatbot, which may sound gimmicky, but is surprisingly useful.

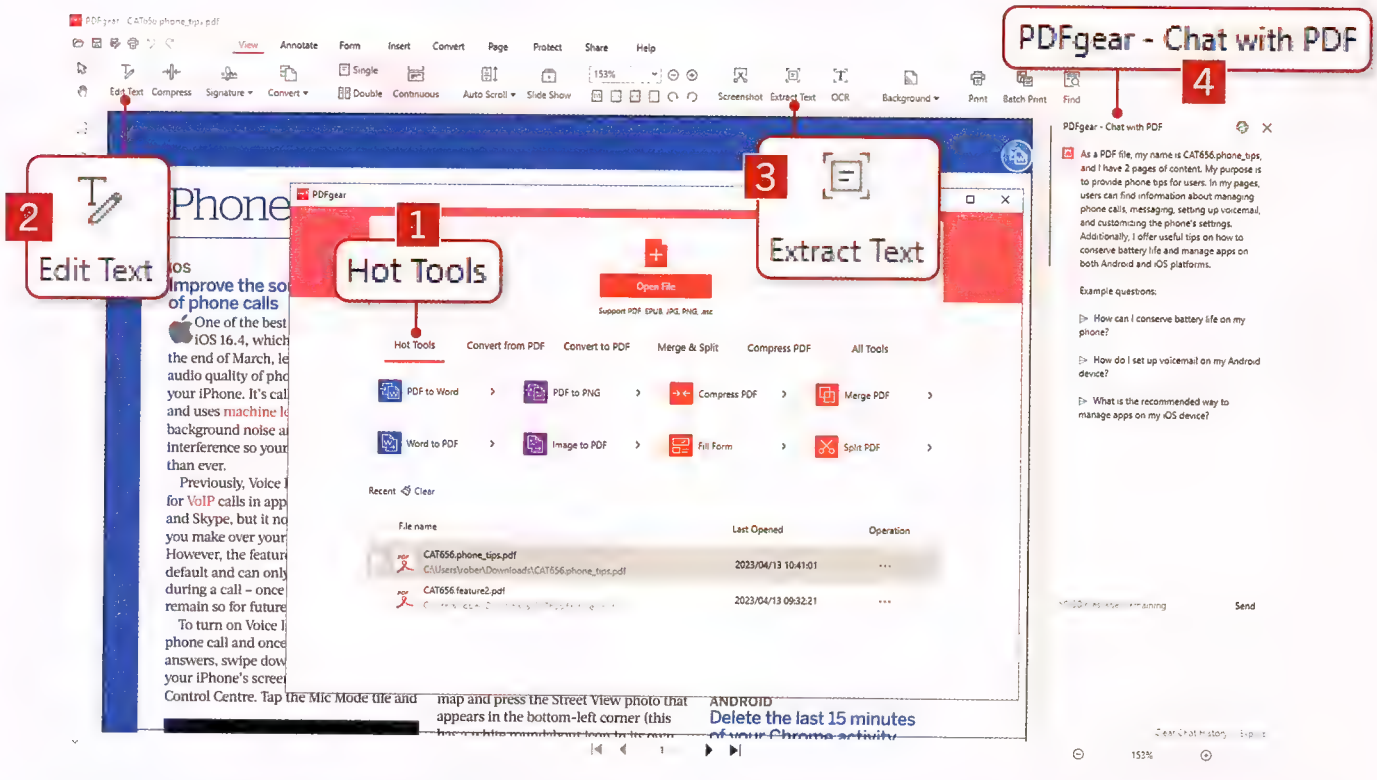
PDFgear's simple tabbed interface makes it easy to open existing PDFs and convert them to formats including Word, Excel, RTF, JPEG and PNG – you can also convert files in those formats to PDF. Other options let you merge several PDFs into one file, split a PDF into separate pages and compress a PDF to reduce its file size.

However, it's when you open a PDF that you'll see PDFgear isn't your average free PDF editor. The main toolbar includes options to edit the text in PDFs and add your signature – features you have to pay for in software such as Adobe Acrobat. You can also extract the text from documents and images using OCR, and either copy it to your clipboard or save it as a text file in just two clicks – again, an option usually limited to 'premium' subscriptions.

> "This updated version adds an AI-powered chatbot, which may sound gimmicky, but is surprisingly useful."

Standard PDF tools such as annotating and highlighting documents, rotating and cropping pages, and encrypting files with a password, are refreshingly easy to use, and you can share PDFs by email directly from the program. As for the AI chatbot, click the Chat Now button and it will summarise the current PDF, then let you ask questions about specific aspects of its content.

The only thing we don't like is that PDFgear sets itself as your default PDF viewer without asking first, though you can disable this in its settings. That said, after trying the software, you may wonder why you'd use anything else.



1 The Hot Tools tab of the main PDFgear window gives you instant access to some of the program's most useful options, including converting PDFs to and from Word format; merging, splitting and compressing files; and filling in forms.

2 Click the Edit Text button to edit the text in a document. Unlike other free PDF tools this option lets you delete text and rewrite it in the same font, as well as annotate and highlight it, so you can change anything you're unhappy with.

3 Click the Extract Text button, select a section of text you want to extract from the PDF and click Done. A window will open that lets you copy the text to your clipboard or save it as a file. You can use OCR to extract text from images.

4 PDFgear's new AI-powered chatbot summarises the content of the current PDF then suggests questions you may want to ask about the text. You can also submit your own questions, up to a maximum of 50 messages per document.

Licence GPL v3, various | https://vanillaos.org

VANILLA OS 22.10 R7

With his first taste of the ultra-secure Vanilla OS, Nate Drake finds that plain doesn't by any means equal boring.

"Unlike Ubuntu, which uses Calamares, Vanilla has its own installer. The ISO weighs in at less than 2GB and the install footprint is about 23GB."

Left: You can install apps, as in regular Ubuntu, using pre-selected package managers such as Flatpak.

It might be plain, but year after year, vanilla is rated as one of the most popular ice cream flavours. This philosophy has been copied into Vanilla OS, which while based on a standard install of Ubuntu 22.10 with Gnome, has one important difference: it can be immutable. In plain English, this means you can change system files from being editable to read-only, so no one can install new programs or make system-wide changes.

The read-only root filesystem, care of ABRoot, certainly has its uses: if setting up a computer in a school or kiosk, it prevents people adding new programs. It also makes it much harder for malware to take root in the OS. This read-only policy only applies to system data; you can still download and edit files in your home folder.

Unlike Ubuntu, which uses Calamares, Vanilla has its own installer. The ISO weighs in at less than 2GB and the install footprint is about 23GB. Unlike previous versions, Vanilla now also supports manual partitioning of the hard disk via GParted.

Once the desktop loads, the First Setup tool opens. This is where you can choose a colour scheme, as well as one or more package managers. Currently only Flatpak or AppImage are available, though Vanilla is working on reintegrating Snap in future versions.

You're then offered the chance to install core apps, as well as LibreOffice and basic utilities such as Sound Recorder. The setup tool also offers to install TimeShift, which makes snapshots of your system.

If you're running Vanilla in a VM, it offers to install its own set of VM tools. You can also install restricted codecs and fonts from here, which Vanilla can't bundle for copyright reasons. Once you've chosen what to install, enter your password and Vanilla does the rest.

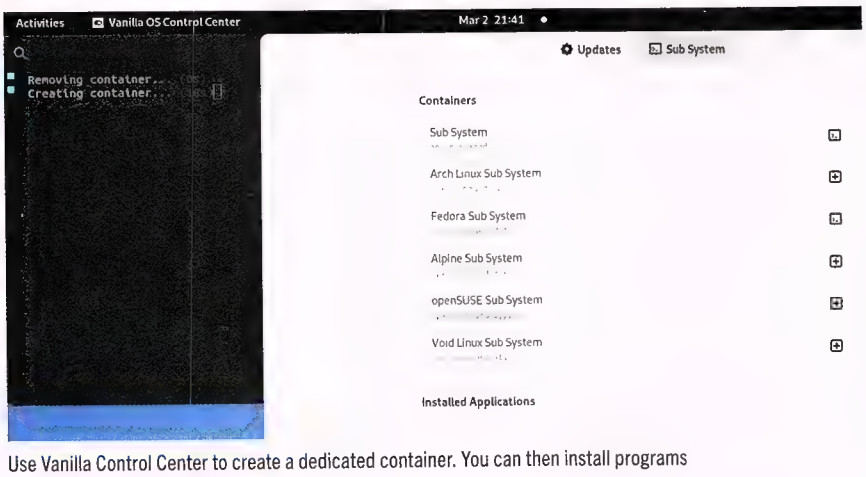
After rebooting, you can start using Vanilla. We recommend you check out the OS's excellent online Handbook for installing applications, because due to the read-only root filesystem, you can't just fire up the terminal and run **sudo apt-get install** .

The simplest way to add new programs is to open Gnome Software, just as you would in regular Ubuntu, and install via the GUI using the package managers you selected during setup.

The default package manager is Apx. It allows you to install applications in separate virtual containers. Ubuntu, Fedora, Arch Linux and Alpine Linux are supported. Once you create a container from the command line or Vanilla Control Center for an OS, you can install programs for it via the command line.

Any installed apps are integrated into the host system and can access its hardware. However, for security reasons, an app in one container can't interfere with the operation of those in other containers. Installed apps appear in the Applications menu, as well as the Vanilla Control Center.

If you use Apx from the main line to install a new program, the OS does this into a new container by default. This is why although a vanilla install uses only 23GB, you'll likely find the hard drive filling up fast.



Use Vanilla Control Center to create a dedicated container. You can then install programs to it via the command line.

The read-only root filesystem and separate apps containers provide great security but a potentially large install footprint.

Nate Drake

★★★★☆

apc HIGHLY RECOMMENDED

iPadOS 15 or later | $30.99 (for iPad; universal licence $259.99) | affinity.serif.com

AFFINITY PHOTO 2

Serif's powerful editing app gets a serious update

Serif's Affinity suite rivals Adobe in bringing pro-grade image editing without a subscription to Macs and iPads. The latest releases of the three Affinity apps, released as version 2 rather than a free update, may mean you have to pay once more, but a universal licence – which gets you all apps on all platforms with no extra costs – is about the same as one year of equivalent Adobe apps. There's a 30-day free trial too.

The iPad version of Affinity Photo 2 is probably the most interesting of the updates, as it has the broadest appeal and is cheaper than the Mac app (which costs $109.99 if you buy it separately). And while the both Mac and iPad versions takes on Adobe Photoshop, the Mac version lacks the organisational tools of Adobe Lightroom or the browsing capabilities of Adobe Bridge, and there is no equivalent on iPad either, which is a shame.

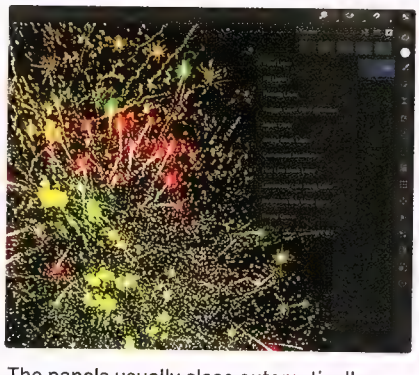
With Affinity Photo 2, you get a layer-based image editor that's split into 'personas'. The Photo persona is a straightforward image-editing app, though a powerful and complex one that will require time spent in the online manual and tutorials to master. The Develop persona is for processing your Raw files. Liquify is for heavy retouching that's more like sculpture in the way it moves pixels about, and Tone Mapping is for HDR. Finally, Export is for creating the perfect output file for your needs. Personas take over the interface of the app, changing the available tools and options, rather than appearing in a floating window.

Users of the first version of Affinity Photo on Mac will find a great deal of refinement but little that's actually new, though the iPad version now features quick menus and a command controller

Above: Panoramas can be automatically stitched together from a series of multiple images.

APP TIPS GETTING STARTED WITH AFFINITY PHOTO 2: HANDY HINTS

Hold the '?' button in the bottom right of the iPad interface, and you'll get a helpful overlay that makes up for the lack of tooltips.



The panels usually close automatically when you tap on your image, but you can keep one open with the pin icon at the top right.

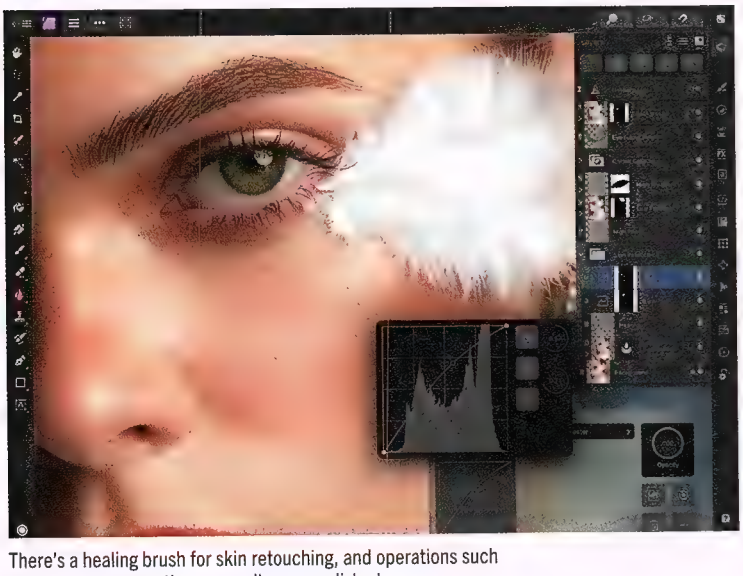
Swipe down with three fingers on your document and a customisable quick menu will open, with shortcuts for common tasks.

Affinity Photo 2 for iPad has the blend modes you'd expect from the desktop version.

to speed up workflows, a compact mode to make the best use of limited screen size, and a resource manager for linked content.

The Layers palette has had an overhaul, making masking, clipping and reordering clearer; plus, there are a great many more non-destructive options when masking (the entire Develop persona is non-destructive too, appearing as a layer with adjustable settings).

Additionally, you have the option to export straight to the WebP format or open the HIF files from Canon cameras.



There's a healing brush for skin retouching, and operations such as frequency separation are easily accomplished.

Not about the smarts

While Adobe is pushing Photoshop in an interesting direction with its neural filters and Sensei-powered smarts, you won't find any of that in Affinity Photo 2. The most automatic thing is the selection of a correction profile for your Raw files. Otherwise, you're doing everything by hand, with Apple Pencil on iPad, and Force Touch and Touch Bar on Mac to assist. It's not just an image editor though, as natural media brushes, vector illustration, and type handling all come under its purview.

As part of the Affinity suite that centres on Publisher – which is now available on iPad for the first time – Affinity Photo 2 fits in nicely, but works well as a standalone app too. While not an app for absolute beginners, the ability to dip in and learn without an ongoing subscription is hugely valuable.

Serif's pro-grade image-editing app is now even more essential.

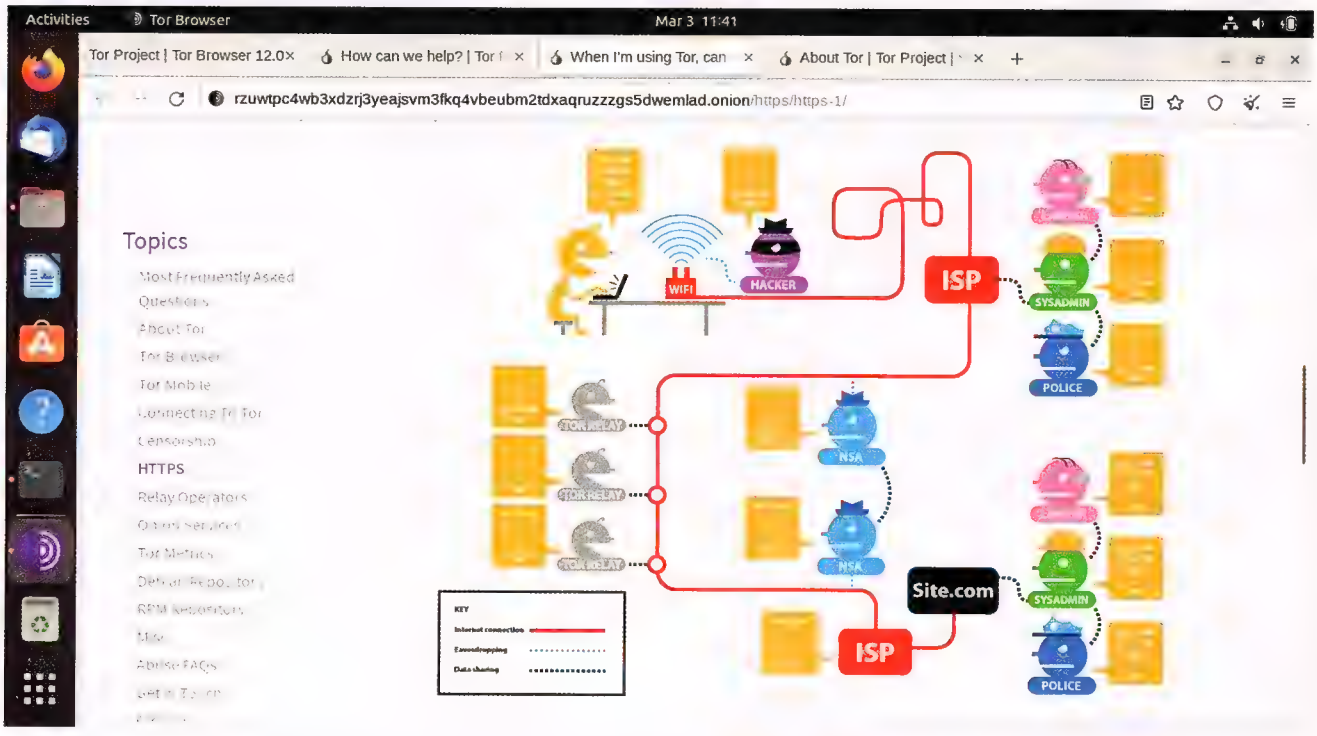
Ian Evenden

★★★★☆

Licence: 3-clause BSD | www.torproject.org

TOR BROWSER 12.0.3

Nate Drake nosedives into the dark net with the Tor Browser and is blown away by its new censorship-resistant features.



Since 2008, the Tor Browser has been making waves in providing online privacy. Successive versions are based on Firefox ESR (in this case version 102.8) and come with a number of features to make you as anonymous online as possible. Since our last look the Tor Browser has seriously upped its game in terms of protecting your privacy and evading censorship.

Onion 101

The Tor Browser uses so-called onion routing to keep your location and data safe. It works by encapsulating and removing various layers of the encryption, much like peeling an onion.

When the Tor Browser first launches, by default it searches for a list of Tor entry nodes, sometimes known as guard relays, and downloads the public encryption key for one at random. It then establishes an encrypted connection to this entry node.

The data packets sent to the entry node can then be encrypted and forwarded to a second Tor relay, using the second relay's public key. The second relay has no record of the IP address you used to connect to the original entry node. It doesn't even have any way to determine that the connection has come from an entry node.

Nevertheless, the second relay can establish a secure, encrypted connection to the original entry relay, allowing the Tor Browser to send data packets to a third relay, which only it can decrypt. This is the nature of a Tor circuit – a path through the Tor network where each successive relay can only forward data packets and decrypt only those encrypted with its own public key.

When the circuit is complete, you can browse the web anonymously. Volunteers run exit nodes, which are capable of connecting to the regular, clear internet, which can then be passed back to you along the circuit you've established. In this case, the successive layers of encryption are removed from data packets.

The bottom line is that as data packets move from one Tor node or relay to the next, no single node knows both the origin and final destination of that data.

Hidden services

Although the Tor Browser can access the regular internet, it's difficult to trust complete strangers who run the exit relays. Any unencrypted information you access on the web via the Tor Browser can, in theory, be harvested or manipulated by bad actors.

Luckily, there's an alternative. Tor hidden services are websites that can only be accessed via the Tor network (usually via the Tor Browser). Their addresses reflect the public key of the service in question, so usually resemble gibberish. They use the TLD .onion; the New York Times, for instance, can be found via **https://nyti.ms/41Muny4/**.

Above: The Tor Browser protects your privacy by routing your data packets through multiple relays.

Each time you connect to a Tor hidden service, your connection is still routed across multiple, encrypted hops, but your traffic never leaves the Tor network. This is much more secure than using an exit relay, provided your chosen website has a .onion address.

Since our last look at the Tor Browser, the first time you visit a website for which there is a Tor hidden service, the browser now asks if you want to prioritise .onion addresses over clear net ones. That means if you go to a regular website, such as that for the Tor Project (**https://www.torproject.org**) itself, in the Tor Browser, you're automatically redirected to its .onion address.

Burning bridges

If you're reading this article and are new to Tor, you've probably noticed a major flaw in onion routing: it requires you to establish a connection to an

entry relay before you can establish a Tor circuit.

These entry relays are listed in a public directory, so can be targeted by bad actors. The Great Firewall of China for instance, often blocks entry relays using DPI (deep packet inspection) and impersonating other nodes.

In theory, you can get around this restriction using a bridge. These are slightly-modified Tor relays operated by Tor volunteers that aren't publicly listed. That means that there's no immediate way to detect and block them, because the IP address isn't publicly available.

Traditionally, users have connected to bridges either through using the small number of addresses built into the Tor Browser Bundle or by requesting them from **https://bridges.torproject.org**.

Unfortunately there's nothing to stop bad actors in oppressive regimes from doing the same and blacklisting their IP addresses, which is why the Tor Browser now has new bridge bolt-ons for those people living under censorship (see boxout, right).

BUILDING BRIDGES

The latest version of the Tor Browser is more censorship-resistant than ever before. Just click Configure Connection on first launch, then scroll down to Bridges and choose Select A Built-In Bridge.

As you'll see, there are three principle types of bridges (sometimes known as pluggable transports). The obfs4 bridges make your traffic look like random noise, whereas meek-azure makes it seem as though you're connected to Microsoft's Azure servers. The traffic is encrypted in each case. This can be useful if you've already established a Tor Circuit.

Snowflake bridges are maintained by kind volunteers who install a special Firefox, Chrome or Edge browser extension, giving a little of their bandwidth towards helping people in oppressive regimes to connect to Tor. As installing a plugin is much more convenient than running a bridge, the sheer number of Snowflake bridges is (in theory) far too great and changeable to censor effectively.

Snowflake traffic also attempts to disguise itself as web traffic, but various Reddit users have reported that the Chinese government has had some success in blocking Snowflake bridges. It also works via WebRTC which can (in some cases) compromise your privacy.

If you're still having trouble getting online, choose Request A Bridge and complete the captcha to obtain a new address. We noted in our tests, though, that the browser kept saying the captcha was entered incorrectly. You can also request new bridge addresses from **https://bridges.torproject.org/options/**.

Footprints and fingerprints

The Tor Browser is set never to store your browsing history. This means each time you close it, all cookies and other browsing data vanishes. You can save bookmarks, though. You can also download files, but the Tor Project advises against it, as it makes you easier to profile.

There's also a button on the browser bar you can click to immediately close all windows and establish a new Tor circuit, effectively creating a new identity.

While we're on the subject, the Tor Browser is highly resistant to fingerprinting. When you visit a website, your browser supplies a user agent string indicating browser type, your language, certain device settings and so on.

This combination can be used to identify you, which is why the Tor Project's ethos is that everyone using the browser should have the same fingerprint. This is also why the developers strongly advise against adding any other of your favourite plugins or themes to the Tor Browser post-install.

The latest version of the browser actually only comes with one plugin: NoScript, which, in fairness, should stop malicious code dead in its tracks. Previously the Tor Browser included HTTPS Everywhere but this is no longer necessary as Firefox can force https-only mode.

Multi-locale

If English isn't your first language, previous versions of the Tor Browser required you to visit the Project website and download an additional language pack. The latest version of the browser now comes with all supported languages bundled.

This means that on first install it matches itself to the system language. You can also change the language from the browser settings without downloading more files. This latest stable release is also the first to support Albanian and Ukrainian.

Tor torments

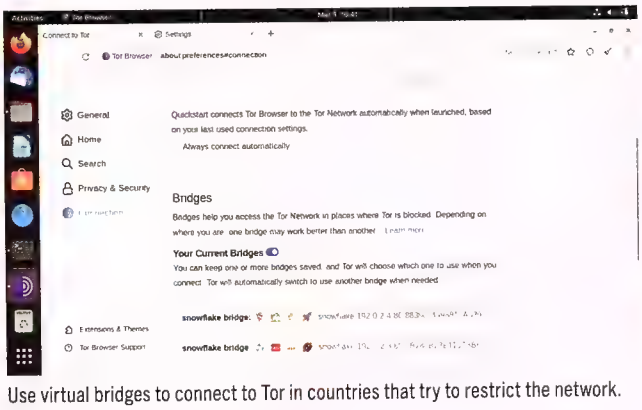
If you've never used the Tor Browser before, you need to prepare for the fact that routing your data packets through multiple relays is a slow process. If you remember the heady days of dial-up internet, you'll have some frame of reference. This makes the browser unsuitable for downloading large files, using with P2P software or streaming video.

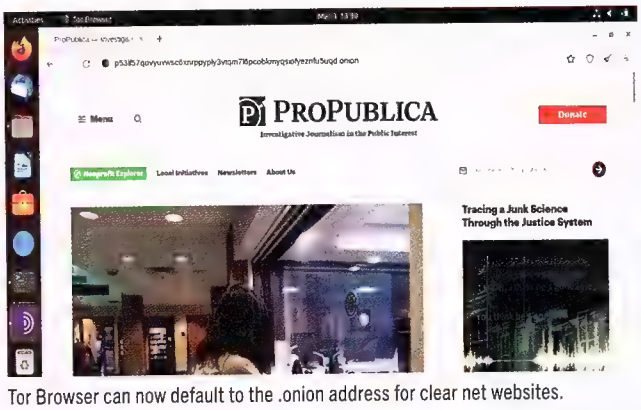
There's a built-in onboarding tour on the homepage, which lists some of the key features. There's also a built-in user manual.

Tor data packets are also very distinctive and are sometimes blocked by ISPs who are convinced that the browser is only used for illegal purposes. You may be able to circumvent this, however, using an obfs4 bridge (see boxout).

The Tor Browser is great for concealing your location, as long as you can live with limited features and slow browsing.
Nate Drake

★★★½☆

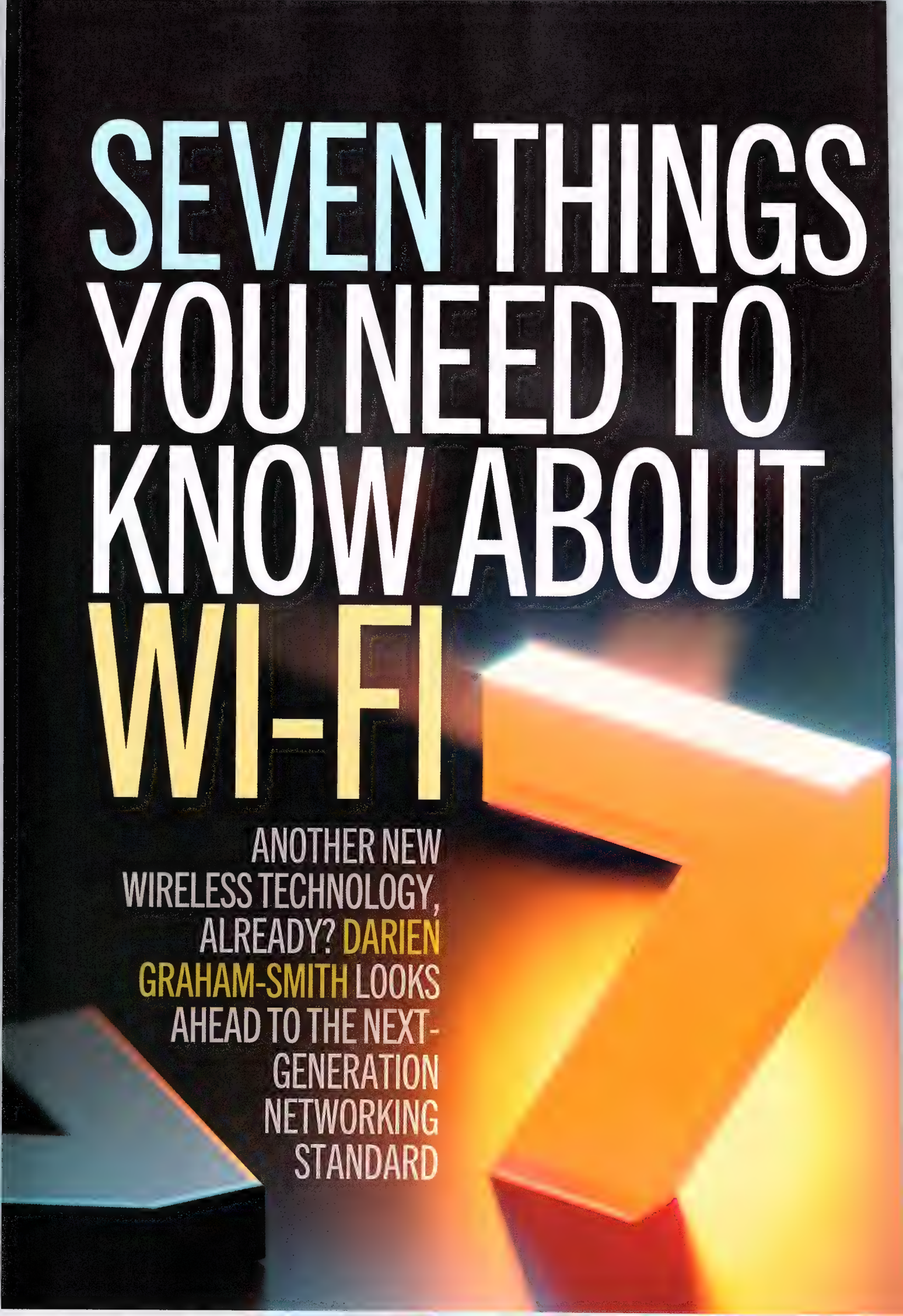

Tor Browser about:preferences#connection
General
Home
Search
Privacy & Security
Quickstart connects Tor Browser to the Tor Network automatically when launched, based on your last used connection settings.
Always connect automatically
Bridges
Bridges help you access the Tor Network in places where Tor is blocked. Depending on where you are, one bridge may work better than another.
Your Current Bridges
You can keep one or more bridges saved, and Tor will choose which one to use when you connect. Tor will automatically switch to use another bridge when needed.
snowflake bridge
snowflake bridge
Use virtual bridges to connect to Tor in countries that try to restrict the network.



Tor Browser can now default to the .onion address for clear net websites.

SEVEN THINGS YOU NEED TO KNOW ABOUT WI-FI

ANOTHER NEW WIRELESS TECHNOLOGY, ALREADY? DARIEN GRAHAM-SMITH LOOKS AHEAD TO THE NEXT-GENERATION NETWORKING STANDARD



IT'S RIGHT ON SCHEDULE

If you're not ready for Wi-Fi 7, that's understandable. Most of us haven't caught up with Wi-Fi 6E yet, which only hit the mainstream around 18 months ago.

Strictly speaking, though, Wi-Fi 6E wasn't a new standard. While it introduced support for wireless networking in the 6GHz frequency range, it's otherwise based on exactly the same 802.11ax specification as Wi-Fi 6. It could justifiably have been called Wi-Fi 6.1.

So really it's getting on for four years since the last major Wi-Fi update – and when you look back over previous releases, that's about par for the course. From the original 802.11b release in 1999 onwards, each generation of the technology has reigned for between four and six years, before being replaced by something smarter and faster. Wi-Fi 6 was adopted in 2019 and Wi-Fi 7 is due to be finalised in 2024, so it fits the pattern perfectly.

That doesn't mean you'll necessarily have to wait until next year to move up to Wi-Fi 7. The core features and technologies are already firmly defined, allowing manufacturers to build and release Wi-Fi 7 hardware well ahead of the final sign-off. Indeed, as we'll discuss, you can already buy a handful of Wi-Fi 7 devices.

That's how it usually goes in the world of Wi-Fi: both 802.11n and 802.11ac routers were available long before the underlying standards had been finalised. Indeed, while Wi-Fi 6 was released in 2019, the standard wasn't fully signed off until February 2021 – 16 months after we'd reviewed our first Wi-Fi 6 router, the Asus RT-AX88U.

RIGHT The Netgear Nighthawk RS700 Wi-Fi 7 router will be on sale soon.

IT HAS TWICE THE BANDWIDTH OF WI-FI 6 AND 6E

Wi-Fi 6 and 6E benefit from fat 160MHz channels, twice as wide as those specified in the previous Wi-Fi 5 standard. Wi-Fi 7 doubles this again, with the maximum supported channel size going up to 320MHz. That increases the nominal data rate from 1.2Gbits/sec to 2.4Gbits/sec per stream.

This benefit doesn't apply on every radio band. There simply isn't enough contiguous spectrum available within the 2.4GHz or 5GHz frequency ranges to accommodate such an enormous data channel.

However, while the 6GHz band offers a broad permitted frequency range, stretching from 5.925GHz to 6.425GHz in Australia. Wi-Fi 6E can use only a single 160MHz chunk of that spectrum, but with Wi-Fi 7 there's enough space for a full-width 320MHz channel – plus a second, non-overlapping 160MHz channel alongside it, should you want to run a second network. In the US, the available frequencies go all the way up to 7.115GHz, allowing three 320MHz channels to coexist without interference.

To get the best performance from these ultra-wide channels, Wi-Fi 7 makes use of a feature called preamble puncturing, which allows the router to selectively avoid transmitting on specific frequencies within the 320MHz channel where interference is detected. This was an optional capability of Wi-Fi 6, but on next-generation networks it will be de rigueur.

IT PACKS IN DATA MUCH MORE DENSELY THAN PREVIOUS WI-FI STANDARDS

Wi-Fi 7 uses the same OFDMA technology as Wi-Fi 6, which divides up the airwaves according to demand (and the router's QoS rules) so that multiple devices can smoothly share the available bandwidth.

However, each "slot" in a Wi-Fi 7 connection carries more data than before, thanks to the use of higher-order QAM – or, to give the technology its full name, quadrature amplitude modulation. This is a technique used to encode data in a radio signal by adjusting the amplitude and phase of a pair of carrier waves. Different combinations create different wave patterns, which can be used to represent different binary values.

Since the radio waves themselves are analogue, the number of values that can be represented is effectively infinite – the only limitation is how precisely the radio transceiver can modulate and decode the waves. Wi-Fi 5 used a 256-QAM system, where each wave pattern encoded eight bits of data, while Wi-Fi 6 increased this to 1,024-QAM, supporting ten bits of data. The latest Wi-Fi 7 standard further boosts this to 4K-QAM, meaning that the same radio patterns that used to convey eight or ten bits of data can now carry 12.

Wi-Fi 7 also brings upgraded MIMO capabilities, enabling devices to communicate using up to 16 antennas at once – twice as many as Wi-Fi 6. In practice, though, we doubt you'll ever see a 16x16 MIMO connection: multiplexing pushes up the cost and complexity of the design considerably, which is why consumer Wi-Fi 6 and 6E devices rarely go beyond 2x2 MIMO.

IT ENABLES DEVICES TO COMMUNICATE ON MULTIPLE RADIO BANDS AT ONCE

We've mentioned that Wi-Fi 7 devices can use MIMO to communicate across 16 antennas at once. However, that only works on a single radio band: Wi-Fi 7 also introduces a new feature called Multi-Link Operation, or MLO. This means devices can establish multiple simultaneous connections to the router across combinations of the 2.4GHz, 5GHz and 6GHz frequency ranges.

It's a revolutionary enhancement. Multiple radio bands have been supported since 802.11n, but until now each device has had to connect to the router on a single nominated band. The ability to aggregate two or three links together enables bandwidth to be multiplied at a stroke.

As well as increasing throughput, MLO can provide more reliable connections: using traffic analysis and QoS rules, the router can spot interference, calculate priorities and decide which frequencies to use for communicating with different clients.

ABOVE MLO will boost throughput and reliability.

WI-FI 7 ISN'T JUST FASTER, IT'S MORE RESPONSIVE

Most people's wireless networks can already go faster than their internet connection. There's nothing wrong with that – if it were the other way round, you'd be paying your ISP for bandwidth you couldn't use. But you might well be wondering what the point is in introducing even faster wireless.

One answer is that internet connections keep on getting faster. In my own testing, I've found that the latest Wi-Fi 6E routers typically transfer data at between 500 and 800MB/sec at short range, falling to around 250Mbits/sec in other rooms. In the next few years, as gigabit and even multi-gigabit broadband lines become cheaper and more widely available, a growing number of households are going to find that a Wi-Fi 6 router holds them back.

Remember, too, that not all networking involves the internet. Our homes contain a growing number of smart appliances, which are continually talking to hubs and to one another. And while we're storing more and more data in the cloud, domestic NAS systems remain popular for convenient shared storage and bulk archival. The huge bandwidth of Wi-Fi 7 can keep all this data flowing swiftly.

There's another factor to consider, too. Wi-Fi 7 doesn't aim only for faster transfers, but also for lower latency. That means it's ready for the incoming age of game streaming and extended reality – both applications that demand a near-instant response to user input.

It's hard to put a figure on the benefit compared to earlier Wi-Fi standards, because real-world latency depends on the environment. What we can say is that a typical latency of around 10ms has been suggested for Wi-Fi 7, potentially falling as low as 1ms with the right hardware and a strong signal. To put that into context, Nvidia's cloud-based GeForce Now gaming service recommends a latency of 40ms or less for an optimal experience, suggesting that any lag from your Wi-Fi 7 router should be unnoticeable. The latency of your internet connection might be another story, of course.

THE WHEN OF WI-FI

1999

802.11b

The first mainstream Wi-Fi standard, 802.11b operated exclusively on the 2.4GHz band. It offered connection speeds of up to 11Mbits/sec, and could work on any of 13 user-selectable 20MHz channels to avoid interference. The companion 802.11a standard used the faster 5GHz frequency range, but licensing delays and higher manufacturing costs meant it never caught on.

2003

802.11g

The first major Wi-Fi upgrade came four years later and used the same 13 channels as 802.11b, while raising the maximum data rate to 54Mbits/sec. As would become the norm, the specification was designed for backward compatibility with older devices – but if a single 802.11b client was connected to an 802.11g network, it slowed the connection down for everyone.

2008

Wi-Fi 4 (802.11n)

The 802.11n standard was the first to use QAM, and also the first to bring 5GHz networking into the mainstream, although dual-band support was optional. Other innovations included 40MHz channels and MIMO for downlink connections; in theory, these enabled 802.11n to hit download speeds of 600Mbits/sec, although most consumer routers topped out at 300Mbits/sec. In 2018, 802.11n was officially rebranded "Wi-Fi 4".

THE FIRST WI-FI 7 DEVICES ARE ALREADY HERE

If you're eager to get your mitts on a device with a shiny Wi-Fi 7 logo, you don't need to wait until next year. Broadcom has been shipping fully featured Wi-Fi 7 chipsets to device manufacturers since April 2022, and both Qualcomm and MediaTek are now offering their own Wi-Fi 7 solutions.

In fact, two fast-moving Chinese manufacturers are already offering Wi-Fi 7-enabled smartphones, namely the OnePlus 11 5G and the Xiaomi 13 Pro. Other "flagship" Android phones such as the Samsung Galaxy and Google Pixel series will likely follow suit in their next generations. However, iPhone fans may need to wait a little longer, as Apple tends to lag behind the curve when it comes to Wi-Fi: the iPhone 15 is expected to ship with Wi-Fi 6E.

It's a similar situation with laptops and PCs. Wi-Fi 7 (also called 802.11be) expansion cards will probably appear in the second half of 2023, so custom-built PCs with Wi-Fi 7 are only a matter of months away – and existing systems with an accessible PCI-E or M.2 2230 slot should be easily upgradable. Intel says the new networking technology will be standard on Core-powered PCs in 2024.

ABOVE The new OnePlus 11 5G supports Wi-Fi 7.

IF YOU WANT TO BUY A WI-FI 7 ROUTER, START SAVING UP NOW

As with all Wi-Fi standards, Wi-Fi 7 devices can connect to older networks, but if you want to get the best performance you need a matching router – and the first Wi-Fi 7 models on the market are going to be pricey.

One example is Netgear's new Nighthawk RS700, expected to ship in early winter. This distinctive upright router promises a total throughout of up to 19Gbits/sec, with 4x4 MIMO across the 2.4GHz, 5GHz and 6GHz radio bands. It also includes 10Gbits/sec Ethernet for both WAN and LAN ports, to support next-generation internet connections and high-speed wired clients. The US RRP is $700, which will probably translate to around $1,000 in Australia.

If that doesn't appeal, TP-Link has announced four Wi-Fi 7 routers, alongside three mesh systems. The lead product is the Archer BE900, an imposing device which matches the Netgear's US$700 price tag but boasts a cool touchscreen and a faster all-bands speed rating of 24Gbits/sec. This is achieved by adding a second 5GHz radio, which means previous-generation devices won't interfere with full-bandwidth MLO connections. There are also cheaper tri-band BE800 and BE550 variants, plus a gamer-focused Archer GE800, although pricing for these hasn't yet been revealed.

On the mesh front, the star of the show is the TP-Link Deco BE95, which offers a massive total bandwidth of 33Gbits/sec, including twin 6GHz radios rated at 11.5Gbits/sec each. Without a doubt it will be far faster than any mesh we've previously tested – the current titleholder is the Wi-Fi 6E-powered Netgear Orbi RBK963E, which offers an aggregate connection speed of 10.8Gbits/sec across its four radios. The BE95 is also one of the most expensive systems we've seen, launching at US$1,199 for two units. As with the Archer, there are cheaper alternatives – the BE65 and BE85 are rated at 11Gbits/sec and 22Gbits/sec respectively, with pricing and release dates yet to be confirmed.

ABOVE TP-Link's Archer BE900

Finally, Asus has two initial Wi-Fi 7 offerings. The RT-BE96U matches the Netgear's 19Gbits/sec speed rating and its twin 10GbE ports, while the gaming-oriented ROG Rapture GT-BE98 adds a second 5GHz radio, similar to the TP-Link Archer BE900. Currently there's no release date or pricing for these routers, but watch this space.

BELOW Asus' RT-BE96U is rated at 19Gbits/sec.

2014

Wi-Fi 5 (802.11ac)

The adoption of 5GHz networking was slow in the 802.11n era, so the next version of the standard made support mandatory for all clients and gateways. It also defined a new 80MHz channel width, and 256-QAM encoding – a big step up from the 64-QAM used in the previous generation. This enabled connection speeds of up to 867Mbits/sec per stream, or as much as 2.6Gbits/sec for a single client using 3x3 MIMO.

2016

Wi-Fi 5 (802.11ac) Wave 2

Two years after the rollout of Wi-Fi 5, the Wi-Fi Alliance unveiled "Wave 2" , for Wi-Fi 5 devices that supported a range of enhanced tech. These included a 160MHz channel width and an increase in the maximum MIMO configuration from 3x3 to 4x4. Download speeds as high as 6.8Gbits/sec were now theoretically attainable, and Wave 2 also introduced MU-MIMO, allowing multiple devices to enjoy MIMO connections at once.

2019

Wi-Fi 6 (802.11ax)

Wi-Fi 6 brought a new airtime-sharing system called OFDMA, which allowed multiple devices to interoperate simultaneously with minimal interference. QAM capabilities were again upped, to 1024-QAM, and MIMO support was expanded to 8x8 MIMO, enabling a maximum connection speed of 9.6Gbits/sec. Wi-Fi 6 also introduced uplink MIMO for the first time, enabling faster uploads from compatible clients.

2020

Wi-Fi 6E (802.11ax)

More a variant than a true standard, Wi-Fi 6E is a version of Wi-Fi 6 that adds support for connections in the 6GHz radio band. Otherwise, the encoding and transmission systems are identical to those in Wi-Fi 6, but reduced interference in the higher frequency range means that 6E devices often achieve better real-world performance than a standard Wi-Fi 6 connection on the 5GHz band. ■

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50 WAYS TO WORK FASTER

The best way to achieve more is to work smarter, which is why we've put together 50 productivity tips based on our editors' and readers' advice.

Be more productive, they say. Work smarter. Do five days' work in the space of four! Now, we're not suggesting that this article is going to shave two hours from your working day, but even if you find two tips out of these 50 that make a difference then we think that's worth celebrating.

Never has been this subject been more topical, either. On the one hand, we have generative AI tools popping up all over the place that promise the world. Even if that world has six fingers and dresses the Pope in a white puffer jacket. And, as we will see, there are practical ways to take advantage right now.

On the other hand, companies such as Adobe and Microsoft are desperate to keep you subscribing to their software. To do so, they continually update their software with extra tools, many of which (as you will see) can shave a few minutes from a task. Or automate it all together.

So, take a read through our selection – including many from readers – and give them a try.

CONTRIBUTORS

Barry Collins and Tim Danton, Jon Athan, Martin Bailey, Geoff Campbell, Paul McCool, Mike Halsey, John Johnson, Si Mellor, Robert Neuschul, Robert Shifreen, Gerald Tompsett and John Wright.

ADOBE LIGHTROOM CLASSIC

Quickly select people

Recent changes to Lightroom have made it much easier to do precise editing on portraits, without having to import the image into Photoshop.

If you've taken a portrait, it's easy to select the person without having to brush around them first. Open the image in the Develop panel, and then select the Masking tools, which are found by clicking the circular icon under the histogram. You should see small circular thumbnails of any people in your image in the right-hand pane. Click on them and the red mask highlighter will appear over the person in the image.

That should open a sub-menu that allows you to mask only certain body parts, such as hair, teeth, face, skin or lips. Select the appropriate body part or the entire person, then click Create Mask. Now you can make isolated adjustments to exposure, colours, saturation and so forth until you have the desired effect.

ABOVE RIGHT It's now much easier to select people in an image in Lightroom.

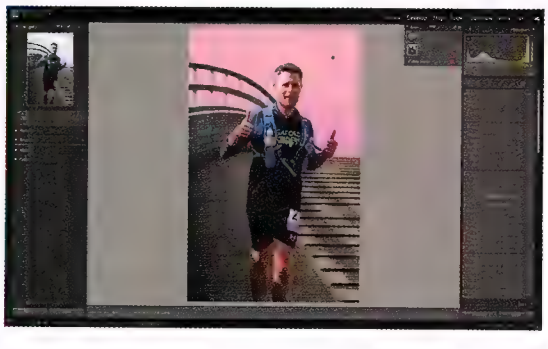
Brighten skies with ease

It's not only people that are easier to select in recent versions of Lightroom. Skies are, too, making it a doddle to breathe life into listless vistas.

Once again, open your landscape image in Develop mode and click on the Masking tools. This time, select the Sky button from the right-hand pane. Once the sky's been selected, you can adjust the temp, tint and hue settings until your dull grey sky is a more pleasing blue, for example.

The advantage of using the Sky mask tool rather than brushes is that the selection is accurate, even picking out the sky in the gaps between the bridge rails in our photo, meaning you don't end up with parts of the image being wrongly coloured or having to spend ages fine-tuning the mask.

BELOW Change the colour of the sky using Develop mode.



Content-aware removal of stray objects

Another way in which Lightroom now saves you from having to dip into Photoshop is by bringing its content-aware removal tools to the software.

If you have a stray crisp packet on a beach or a distracting interloper in a landscape, you can swiftly brush them out of history. In the Develop mode, click on the sticking plaster tool in the right-hand pane, and make sure content-aware removal is selected at the top of the pane that opens – it's the icon that looks like an eraser.

Now brush over the part of the image you wish to vanish away, using the mouse scroll wheel to adjust the size of the brush, if necessary. When you're done, Lightroom should hopefully have removed the miscreant and filled in the background with something suitable.

Automatic people tagging

Any photographer knows that finding the image you want from a Lightroom library that runs into thousands is sometimes painful. Automatic people tagging can make this easier.

"Any photographer knows that finding the image you want from a Lightroom library that runs into thousands is sometimes painful. Automatic people tagging can make this easier."

In the Library panel, press "O" on your keyboard to enter People mode. You should now be presented with a sea of thumbnails showing the faces of anyone in the open picture folder or collection. Lightroom does a pretty good job of matching faces, batching together all the pictures containing a particular person. Enter the person's name beneath their thumbnail, and not only will all the pictures in that folder/collection be appropriately tagged, but Lightroom will attempt to identify that same person in other folders/collections, too.

Lens correct on import

One of the many Lightroom settings you'll normally use is the option to apply automatic lens correction on your images, helping to remove distortion. Lightroom now applies this automatically for modern mirrorless cameras, but doesn't for older DSLR models.

To have all of your images lens-corrected in one hit, you can create a preset that does this at import. Open Lightroom with the Develop panel open on an image to which you've already applied lens correction, and then click Develop | New Preset from the application drop-down menu. Select the option to Check None and reselect the options you want under Lens Correction (such as chromatic aberration and enable profile corrections). Now call this preset "Lens correction" and click Create.

The next time you import a batch of images, you'll be able to select the Lens correction preset from the import menu, saving you from ticking those boxes on every image you edit.

MICROSOFT EXCEL

Deal with comma-separated values

Half the time wasted in Excel is trying to de-mangle badly formatted data. One such example is when you get a list of names in the "Collins, Barry" format and want to break it down into first name and surname. The new TEXTBEFORE function makes this simple.

Let's say the name above was printed in cell A2. To extract the surname alone, you'd enter the following formula:

=TEXTBEFORE(A2, ",")

A2 is obviously the cell we're targeting and the "," part specifies the delimiter, in this case the comma between surname and first name. The TEXTAFTER function works in a similar way.

Insert data from a photo

If there's a table in a printed document that you don't want to go through the palaver of entering manually, you don't have to. Excel now offers the option to insert data from a photo, letting you snap the table using the camera on your smartphone and upload it to Excel. You'll find the Insert From Picture option in the Insert tab of the Ribbon.

You get to review and correct the data before Microsoft imports it into the sheet. The cleaner the photo, the better. Scans or screenshots worked even better in our tests, although we did manage to grab some data off a website simply by snapping our monitor with our smartphone and uploading that file. It's not flawless, but it's much quicker than entering large tables of data by hand.

Get AI to write your formulae

If you struggle to wrap your head around Excel formulae, ask an AI friend to help you. Services such as ChatGPT – now freely accessible via Bing in the Edge browser – are able to write Excel formulae for you.

So, for example, I asked Bing to help me create a formula that counts how many times the word "Google" appears in a spreadsheet. It replied:

"You can use the COUNTIF function to count the number of times a specific value appears in a range of cells. For example, if you want to count the number of times "Google" appears in cells A1 to A10, you can use the following formula: =COUNTIF(A1:A10,"Google"). This will return the number of cells in the range A1 to A10 that contain the text "Google"."

Nice one.

Quickly set goals

Let's say you're running a website and you have a target of achieving an average of 250,000 visitors per month in Q1. You know the figures for January and February, but want to know how many visitors you need in March to hit your target.

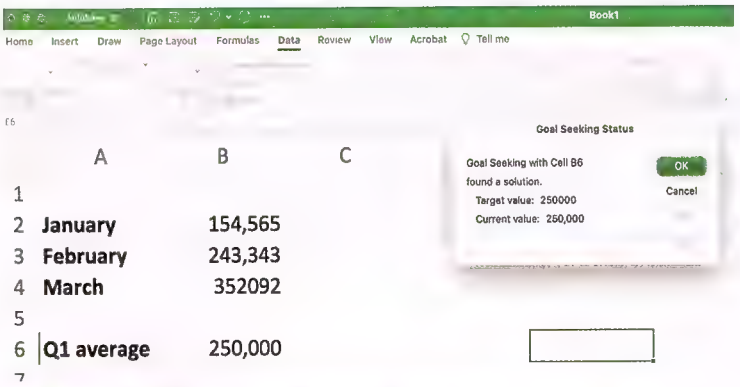
Excel has a brilliant goal-seeking feature that can quickly get you this answer. Open the Data tab and click What-if Analysis and choose Goal Seek from the drop-down. In the example shown below, we need to get our Q1 average in cell B6 up to 250,000, so we select B6 as the Set Cell, enter 250,000 as the To Value and it's the figure in cell B4 that we need to change to know what traffic we need to achieve in March. When you press OK, Excel will do the sums and spit out the goal.

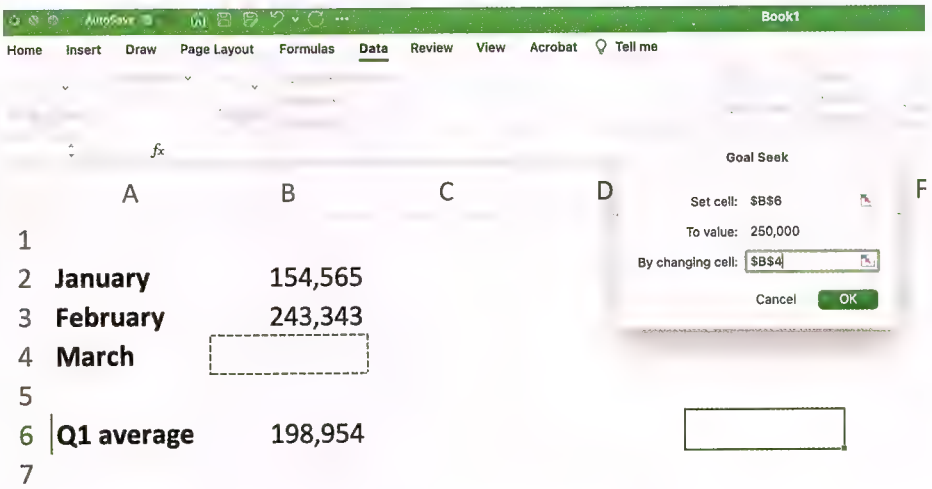
You can later replace the goal figure with the actual figure and the spreadsheet will recalculate the true average.

Filter huge sheets

Filters are a great way to cut through spreadsheets containing huge swathes of data. Let's say you have a spreadsheet containing every transaction from an online store in the past six months. You can use filters to show only the sales of certain products, sales within a given month, sales that exceed $100 and so forth.

You can apply filters by clicking Sort and Filter on the Home tab, and then Filter. A filter dropdown will appear at the top of each column, where you can determine what to filter by. You can filter on more than one column, so if you need to find all sales that exceeded $100 in August, for example, you just need to adjust the filters at the top of the date and transaction value columns.



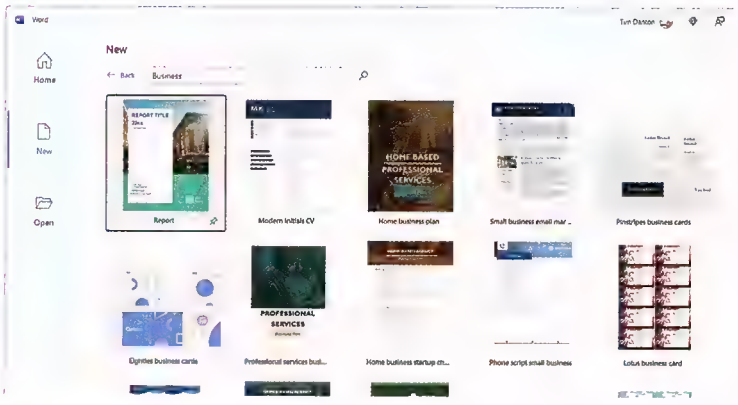


RIGHT Excel's goal-seeking feature is a great way to set targets. **BELOW** Goal Seek will do all the sums for you.

MICROSOFT WORD

Use Word's style sheets

"So simple, so powerful, so widely ignored." That's how Geoff Campbell described Word's style sheets. So, how does he use them, we asked? "I do a lot of load tests, for example, with 40-page results reports in a nice, sober business layout, maybe 5,000-ish words and lots of supporting graphs," he wrote. "They all share exactly the same look, generated by the style sheet, so that reports from a decade or more ago are instantly recognisable against ones done last week, and I know that if I tweak a paragraph attribute it will be reflected through the whole document instantly. It's a massive time-saver."



RIGHT Save time by creating your own Word

Roll your own Word templates

Martin Bailey advocates "roll your own templates", using them for documents that "I'm going to need again: add the headings and cover sheet, and save it as a template before adding any content". In addition, he uses ClipName to "turn filename paths into URLs or clickable Word links". This simple (and free) utility adds an extra item to Windows Explorer's right-click menu.

Co-author documents

It isn't only Google Docs that lets you collaborate on documents in real-time. You've been able to co-author in Word since 2016, though it took Microsoft a further five years before adding support for encrypted documents. Naturally, Microsoft insists the file is saved to OneDrive (or SharePoint Online), at which point you can invite people to collaborate via the Share dialog. As the saying goes, a document shared is a document finished in half the time.

POWERPOINT

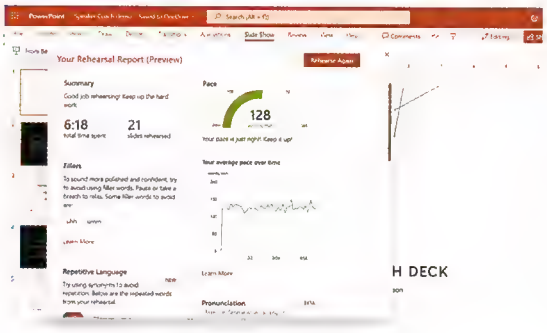
User Surface Earbuds to control your presentation

Everyone knows you can press the spacebar or left-click on a mouse to head to the next slide in a presentation, but for the last word in cool you really want to use the Surface Earbuds. After pairing them with the Surface Audio app in Windows 10 or 11, you can use gestures to control presentations.

There's one more hurdle, which is to activate the earbuds. First, start a presentation (by pressing F5), then right-click on the slide. Under "Surface Earbuds Settings" choose "Use Gestures to Control Presentation". It will now work for all presentations.

The actions are intuitive: simply swipe forward or backward on the left earbud to, well, go forward or backward. You can double tap to play or pause videos, too.

BELOW Speaker Coach will improve your presentation technique.



H DECK

Pre-record your presentations

If you find yourself repeating the same presentation online over and over again, we suggest you use the option in PowerPoint to record yourself doing it. You can still answer "live" questions at the end of the presentation, of course, or share it with your audience and let them view the session in their own time. Click the Cameo option from the Record ribbon, and you can insert yourself into the presentation complete with numerous effects and blurring options. It's all intuitive, so have a play and, when you're happy, click Export Video to share it with the unsuspecting world.

Rehearse with Speaker Coach

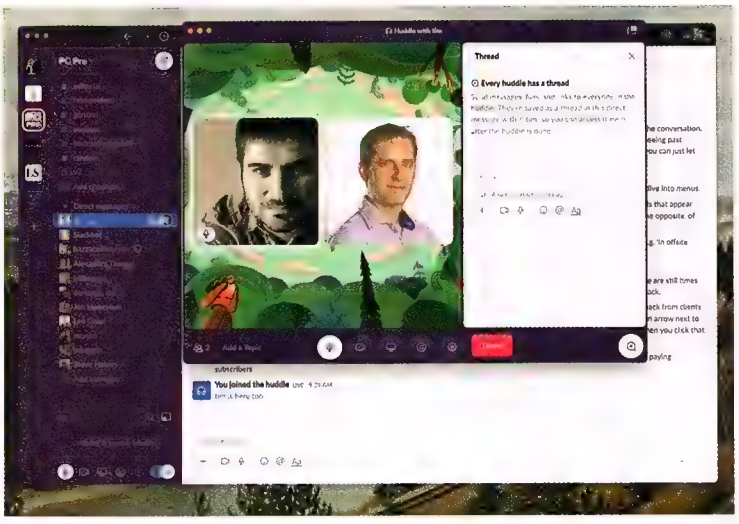
This isn't a short-term time-saver but one for the long term. You see, Microsoft has a tool that allows you to rehearse your presentations in private; but Speaker Coach doesn't just sit there and watch, it gives you a report at the end of the presentation with feedback on your pitch, pacing, over-use of euphemisms and much more besides. For instance, it would probably tell us we're being far too wordy right now.

To use Speaker Coach, open your presentation in PowerPoint for the web in Microsoft Edge. Obviously, you'll need to be signed in via your Microsoft account. Click on the opening slide and then choose Slide Show from the Ribbon. Now hit "Rehearse with Coach" and, after giving Edge access to your microphone, talk away as you normally would. When the slideshow ends you will be given a report, complete with surprisingly useful insights.

Insert Apple photos without conversion

Here's a quick tip for anybody who still converts Apple photos before inserting them into Office applications: you don't have to. In fact, ever since summer 2020 all the Office apps have supported HEIF and HEIC images (as taken by iPhones), so all you need to do is browse to the pics in question via the Insert tab (then select Pictures | From device).

SLACK



RIGHT Huddles allow all members to join an online call.

Meet in Huddles

Part of the problem with services such as Slack is that you can spend 20 minutes trying to sort something out in text messages that you could have settled with a two-minute chat. Huddles are a clever solution to that problem.

Available in any Slack channel, they allow all members to quickly join an online call and discuss something. Anyone can dip in and out of a Huddle, and you don't have to set up invites or schedules. Just flick the Huddle switch at the bottom of the channel's menu and join in by voice or video, or type the command /huddle.

Our only criticism of Slack Huddles is that it's not always obvious when somebody has started one – the notifications could be better.

Create a to-do list

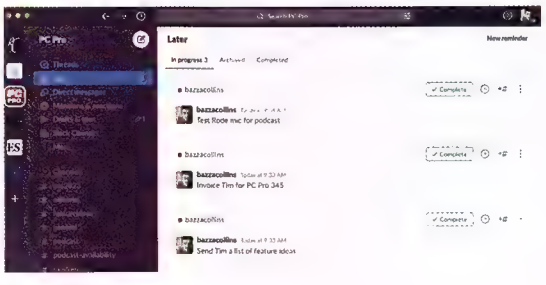
Another of Slack's irritations is its immediacy: people see you're online and expect an immediate answer. That's not always possible and it's easy to lose track of conversations, but one way around this is by saving messages. Click on any individual message and you'll see a small bookmark icon that allows you to save it. The sender doesn't see you've saved the message, but it's then lodged in your saved message queue, creating a pseudo to-do list of messages you need to reply to when you have time.

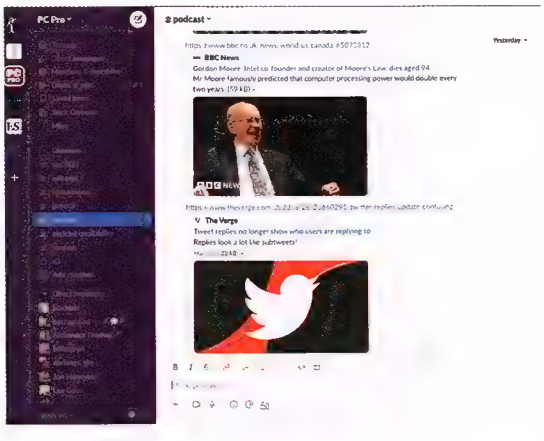
If you need to create a to-do list item yourself, you can direct message yourself and then save that message.

Include conversation history

A lot of Slack communication takes place in DMs, between a select group of team members. If you want to bring a colleague into the conversation, you would – until recently – have had to bring them up to speed on what's previously been discussed, as Slack barred them from seeing past conversations. Now when you add a colleague to a DM group, there's an option to let them see previous conversations, meaning you can let them read back and bring themselves up to date. Just make sure there's nothing sensitive in there.

BELOW Create your own to-do lists using the bookmark icon. BOTTOM Expand and contract images in links using slash commands.





Master the Slash commands

If you're using Slack on the desktop, the Slash commands can be extremely useful for performing quick actions without having to dive into menus.

Two of the commands we commonly use are /collapse and /expand. The /collapse command hides all in-line images and thumbnails that appear when someone shares a link in a channel. That can make it much easier to skim back through channel discussions, while /expand does the opposite.

> "Our only criticism of Slack Huddles is that it's not always obvious when somebody has started one – the notifications could be better."

Other useful commands are /remind to set a reminder for a @user or a #channel and /status to quickly change your Slack status (such as "in offsite meeting").

Send emails to Slack

Slack was originally pitched as an email killer. It didn't, of course; it just created another way to communicate. And that means there are still times when messages relevant to your Slack conversations are received via email, especially those from external clients who don't use Slack.

However, this is a convenient way to forward emails to Slack channels or conversations, so that you can discuss, say, project feedback from clients with the group. To do this on Slack's desktop app, open the channel/conversation you want to send the email to and click the down arrow next to the channel/conversation's title at the top of the screen. Now select the Integrations tab and then "Send emails to this channel". When you click that, you'll be given a long, obscure email address that you can forward messages to.

Slack can handle attachments, so you don't need to worry about PDFs or suchlike being left behind. This feature is only available to paying subscribers.

OTTER

Install the browser extension

Otter has a Chrome extension (which works in Edge and other Chromium-based browsers) that makes it dead simple to get full transcripts every time you have an online meeting. When the meeting starts, you'll be prompted to record the meeting in Otter, with a live transcript appearing in the browser window alongside your Google or Zoom meeting. It's a handy visual reassurance everything is being recorded properly.

Sync your calendar

Another way to make sure that Otter is transcribing all of your meetings is to sync your calendar with the service. This means that when you create meetings in Google Calendar, you can press a button to have Otter sit in and take notes. A link to the meeting notes is then added to the calendar invite itself, so you can always dip back into your calendar and find the transcript or notes from the meeting.

You can share the meeting notes with the other participants.

You can tweak your Otter settings to have it automatically transcribe all of your video meetings, though there may be some meetings you don't want a record of...

View the auto-summary and action points of meetings

Otter is not half bad at creating automatic summaries of meetings. It seems to listen out for people posing questions, and uses those as a summary headers of the meeting, allowing you to jump straight to the section of the transcript in question.

Otter also lets you go back and pick out the action points from meetings, which can be assigned to attendees. Simply go back through the transcript and highlight any part of the transcript that consists of an action point. A pop-up menu will appear, from which you should choose the tick icon. From here you can assign it to a particular attendee. Action points are later emailed to attendees to ensure they don't drop off the radar.

Share meeting notes

It can, of course, be enormously helpful for all attendees of a meeting to have the Otter transcript, not only the meeting organiser. If you've created the meeting in Google Calendar and pressed the button to add Otter meeting notes, you'll see a drop-down menu that allows you to share the notes with all attendees or other colleagues. That latter option could actually come in more useful, as it allows you to bring absent colleagues up to speed on a meeting they've missed, without you having to give them a verbal or written update yourself, saving time and duplicated effort.

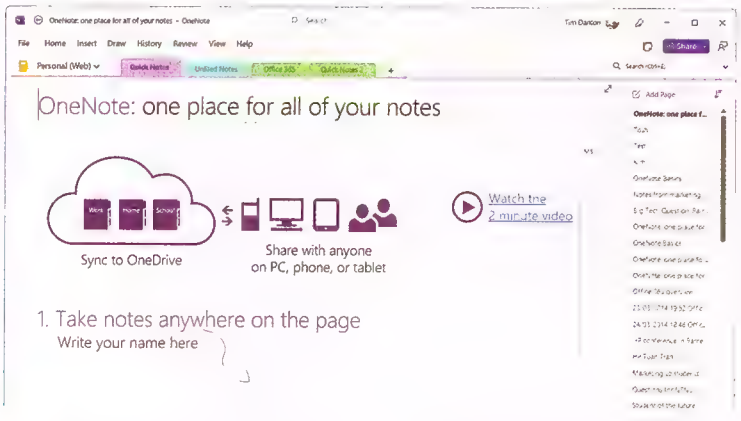
Send Otter to meetings on your behalf

Calendar conflicts sometimes mean you can't be in an important meeting, but it is possible to send Otter on your behalf. Join the meeting and switch Otter on, and you can then put yourself on mute, switch off your video and let Otter take notes for you. Of course, it won't participate, but you will be able to go back into Otter after the meeting has concluded and find out what you missed.

MICROSOFT OFFICE

Exploit OneNote

John Johnson is one of many readers who relies on OneNote. "I can make or refer to notes, update a to-do list or draft emails and documents anywhere from my phone or laptop," he told us, adding that he can "then action those when I'm back at my desk, or vice versa". Jon Athan is another OneNote advocate, and he uses his "phone to dictate in OneNote, pick up on PC".


OneNote: one place for all of your notes
Sync to OneDrive
Share with anyone on PC, phone, or tablet
Watch the 2 minute video
1. Take notes anywhere on the page
Write your name here

RIGHT OneNote lets you take or update notes from any device.

Pin files and folders in the Save dialog

In terms of time spent versus time gained, this must be one of the best tips around. And it's simple. And it applies to Word, Excel and PowerPoint. In the same way that you can pin documents in Explorer and programs to the Taskbar, you can pin favourite documents to the Home and Open views in Office apps.

Open up PowerPoint (or Word, or Excel) and head to the Home dialog. Hover your mouse over the document you wish to pin and Share and Pin icons will appear. Now, when you click on the Pinned option, your document will appear.

The process is a little more convoluted if you want to pin a folder. First, you should choose "Save As" for a currently open file. Then browse to the folder you wish to pin, and right-click it. You'll see the option "Pin to Recent list" on the context-sensitive menu, so click it. The next time you head to the Open dialog, click on Folders (rather than Presentations) underneath the Search box, and your pinned folder will sit in the Pinned section at the top of the list.

GOOGLE DOCS

Auto-generate summaries

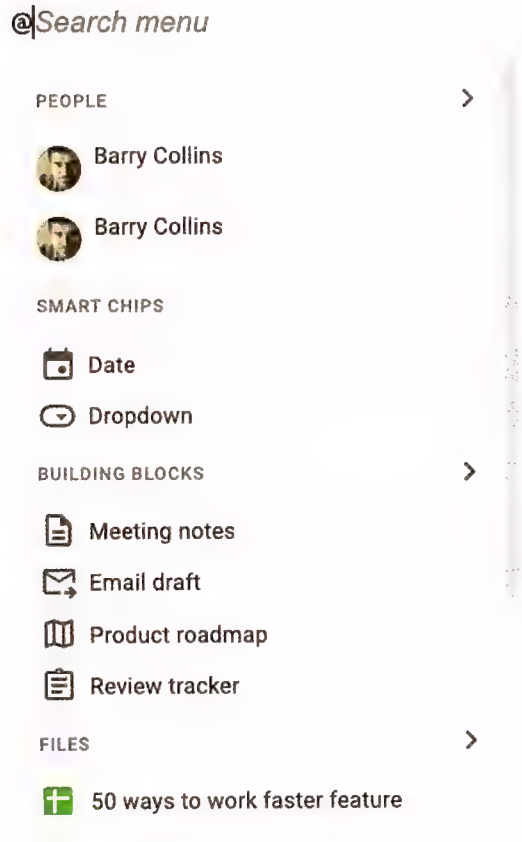
It feels like this is a feature that will soon become commonplace with the advance of AI tools, but if you've got a long report in Google Docs and need a quick summary, Docs can do this for you, provided you're a Workspace subscriber. To create an automatic summary, click View | Outline and then click the little button next to the Summary field. In a few seconds, the AI should give you a heads-up of what the document is about. You can copy and paste that text into the document itself, if you like.

Use Smart Chips

Smart Chips are a relatively new addition to Google Docs. You've probably stumbled across them by accident whenever you've typed the @ sign. When you do so, you'll be presented with a drop-down menu showing a series of items you can insert into your docs.

If you're writing a business proposal and need colleagues to review a certain section, you can grab their attention by typing @ and then their name. If you're setting a deadline for something, you can type @ then the date – and that's smart enough to understand commands such as "next Thursday" or "two weeks" and insert the relevant date.

You can also use smart chips to insert things such as meeting notes or product roadmaps, which is useful for internal project management when you're attempting to keep everything on track.



BELOW Smart Chips let you grab the attention of someone quickly.

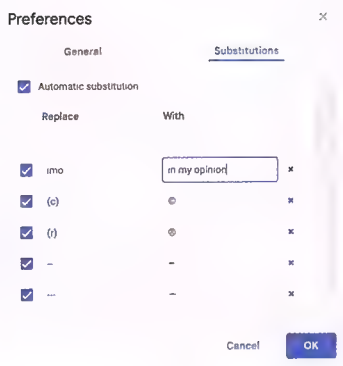
Discuss a doc

Collaboration has always been one of the great strengths of Google Docs – the ease with which two or more people can work on a document simultaneously remains impressive, with updates in real-time. However, that can also lead to edit skirmishes and people working at cross purposes.

If you need to talk to a colleague to sort out a document disagreement, Google Meet is now built into Google Docs. You can talk about the doc with the video window appearing in a sidebar to the right, allowing you to quickly sort out something that might otherwise descend into a long comments thread that takes ages to resolve.

Bring on the subs

If you find yourself regularly typing the same long phrases over and again, you can use substitutions to save some of the fingerwork. This is basically Google Docs' equivalent of a text expander and you'll find it under Tools | Preferences | Substitutions.



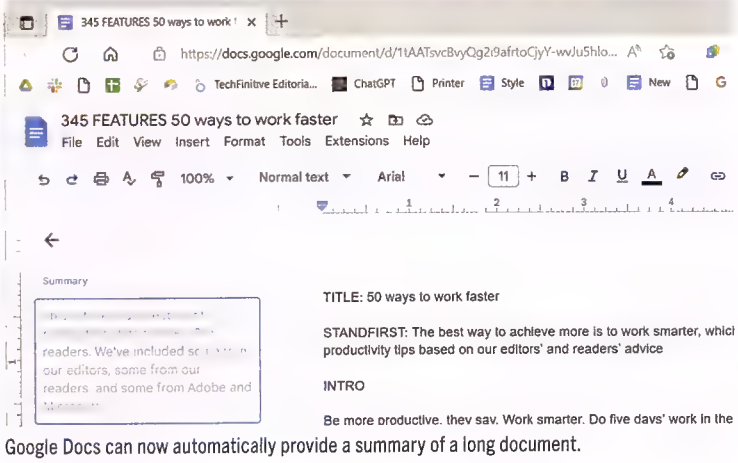
Save typing out long phrases by using Google Docs' substitutions.

So, for example, you could type "imo" and have it automatically replaced with "in my opinion". The annoying thing about Google's substitutions is that they ignore capitals and everything comes out in lower case. Hopefully someone at Google Towers will read this and get it fixed, as imo that's really stupid.

Create a quick PDF

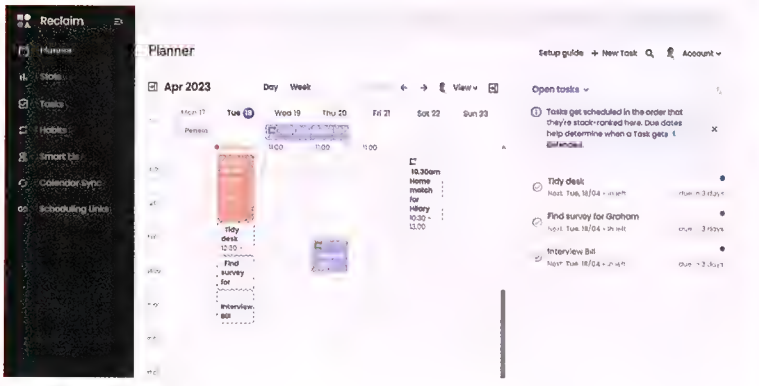
There's a neat piece of URL hackery you can perform to quickly share a Google Doc via PDF, without going through the rigmarole of File | Download | PDF, saving the file locally and attaching it to an email.

Instead, remove the word "edit" from the end of the URL of the doc you're working on and replace it with "export?format=pdf" (without the quote marks). Then copy that URL and send it to clients directly. However, be aware that the PDF is refreshed with the latest version of the document every time someone downloads it. If you want to send a PDF of a document in a fixed state, download and export using the method above.


345 FEATURES 50 ways to work faster
File Edit View Insert Format Tools Extensions Help
Summary
TITLE: 50 ways to work faster
STANDFIRST: The best way to achieve more is to work smarter, whici productivity tips based on our editors' and readers' advice
INTRO
Be more productive, they say. Work smarter. Do five days' work in the

Google Docs can now automatically provide a summary of a long document.

GENERATIVE AI



Shorten search times

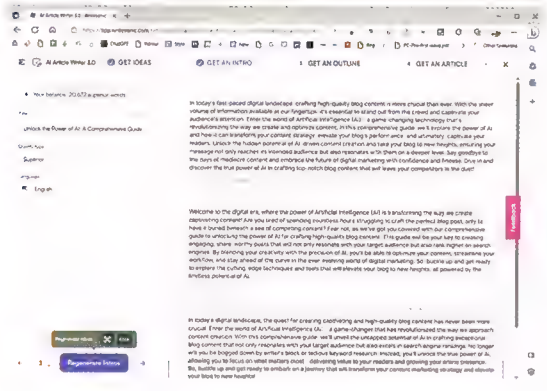
There's a reason that Google's share value dropped by 10 percent when its AI demonstration went wrong: AI-powered search is the future. What's more, Microsoft has already taken a clear lead with its integration of AI into Bing, while Bard remains in the pre-release stage. Say you're looking for cheap phones. A Google search will bring up a list of articles that cover the subject, but Bing's AI tool provides a shortlist of five candidates and provides nearby locations where you can buy them from.

RIGHT Reclaim can help organise your diary effectively.

Sketch out a blog post

There are a huge number of AI-writing tools to play with, but our favourite so far is Writesonic. Let's say you want to write a blog post. Writesonic can take you through the process step by step, providing suggestions along the way – even writing the whole thing for you from a couple of prompts. As ever, it's no substitute for an expert writer, but we think it's better than much of the waffle you see in blog posts elsewhere. Final note: you will need to check details, but thanks to GPT-4 it now adds references.

BELOW Writesonic is a great tool for writing blog posts.



Automatically schedule your diary

There are numerous AI diary tools out there – and Microsoft is going to bring its own once Copilot arrives – but none will magically sort out your life. However, if you're willing to invest some time (and give it access to your Google Calendar and Slack) then Reclaim.ai is well worth investigating. It's most effective when implemented across a team, but even if you're using it just for yourself you should find its automatic scheduling of meetings (and decompression times, and lunch, and team catchups) will save you time – and, just maybe, help you focus, too.

Summarise chunks of text

Just as Otter.ai can summarise meetings, AI tools can turn someone's rambling collection of paragraphs into a neatly formatted summary that's far easier to understand (or you can use it to improve your own writing before it's sent out). You don't even need to pay for these tools, as Bing AI, ChatGPT and Google Bard will all happily convert a few paragraphs of prose for you in a matter of seconds. And, based on our tests, these AI tools cut out the fluff rather than removing the important info.

Let AI do your research

Years ago, Google came along and massively cut the amount of time it took to research a topic. Now AI is doing exactly the same thing. Let's say you want to find out all the training services on offer to doctors. In the past, that meant digging through Google, following links, chasing numerous dead-ends. With AI such as ChatGPT, you ask the question and see what information it brings back. Sure, some of it will be out of date or even wrong, but we guarantee it will shorten the time of your project.

Flesh out your ideas

In a similar way to letting AI do your research, why not let it enhance your creativity with some extra ideas? For example, if you were writing an article for APC about time-saving ideas, you could simply ask it for its suggestions...

FOUR MORE QUICK TIMESAVERS

VIM AND SHAREX

This recommendation came from Gerald Tömpsett. "I've used markup since the 90s and shareX to capture to cloud (imgur) and its OCR to import into Vim. Both are platform-agnostic so work equally well on *nix, macOS or Microsoft. I now use PowerShell along with AutoHotkey to convert between formats."

ENABLE FOREST

Forest is a cross-platform app (plus a Chrome extension in Windows) that allows you to create a "blocklist" of apps to stop you from becoming distracted. So, you set the timer, activate the blocklist, and it won't let you launch those apps until the timer ends or you manually switch it off.

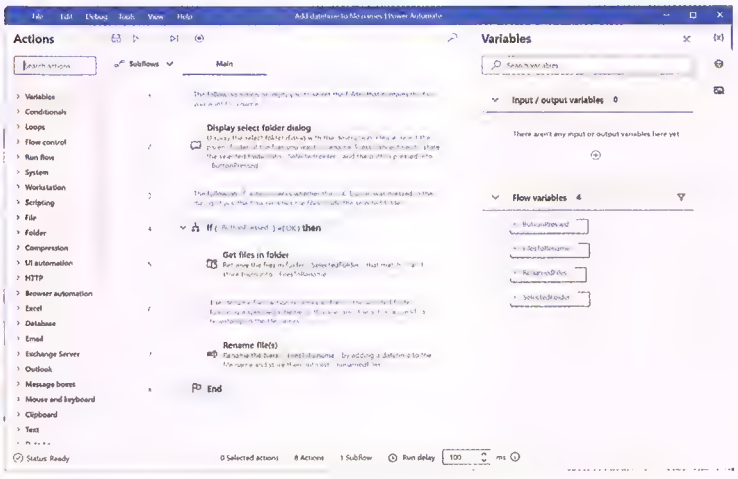
HOT CORNERS

This tip is for Mac owners only. The idea is to start an app (or action) by moving your pointer to one of the corners; by default, the bottom one is set to start Quick Note. You can set more hot corners by heading into System Settings and clicking "Desktop & Dock", then Hot Corners.

AUTOMATE TASKS ON A MAC

If you run repetitive tasks on your Mac – resizing images, say – then it's well worth spending half an hour playing with Automator. It's all based around "workflows", or mini apps, but there's no need for coding skills as Apple provides a bunch of actions (such as creating a calendar event or ejecting a disc) to choose from.

MICROSOFT WINDOWS



RIGHT Power Automate is a powerful tool to automate tasks.

Power up your screenshots

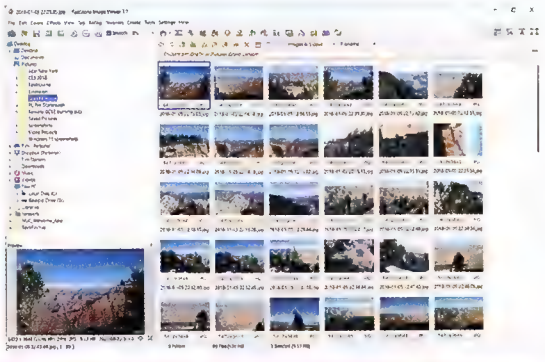
"I now use the newer snipping tool (Windows-Shift-S)," wrote Si Mellor. "Once you draw your box on the screen it copies this straight to the clipboard." But Robert Schifreen upped the stakes. "Greenshot (freeware) is better," he declared. "You can save the clipped image to a file directly, open it in an editor, copy to clipboard, etc. And it hooks into the PrtSc key rather than requiring you to press three keys."

Martin Bailey added that he uses SnagIt for "screenshots on steroids", such as capturing a right-click menu via a delay timer, and uses ArsClip to "store multiple recent clipboard copies across all applications".

Supercharge files and folders

While Mike Halsey describes himself as an "old-skool guy" who sorts "files, emails and documents into a strict folder structure so I can find them again easily", two of our readers had a different approach. "I do a lot of file manipulation," wrote John Wright. "Using bash (via git-bash) is a great way to find, filter and manipulate text files." (we recommend giving Everything a whirl, too). And Robert Neuschul relies on ExamDiff Pro (**prestosoft.com**) to compare files and directories within Windows.

BELOW Fastone Image Viewer is a big upgrade on the Windows version.



Replace the Windows image viewer

Who hasn't been annoyed by the slowness of the Windows image viewer? Or its lack of features. That's why Robert Neuschul switched to Fastone Image Viewer, even using it to "process Raw files as well as JPG/PNG".

Win-X

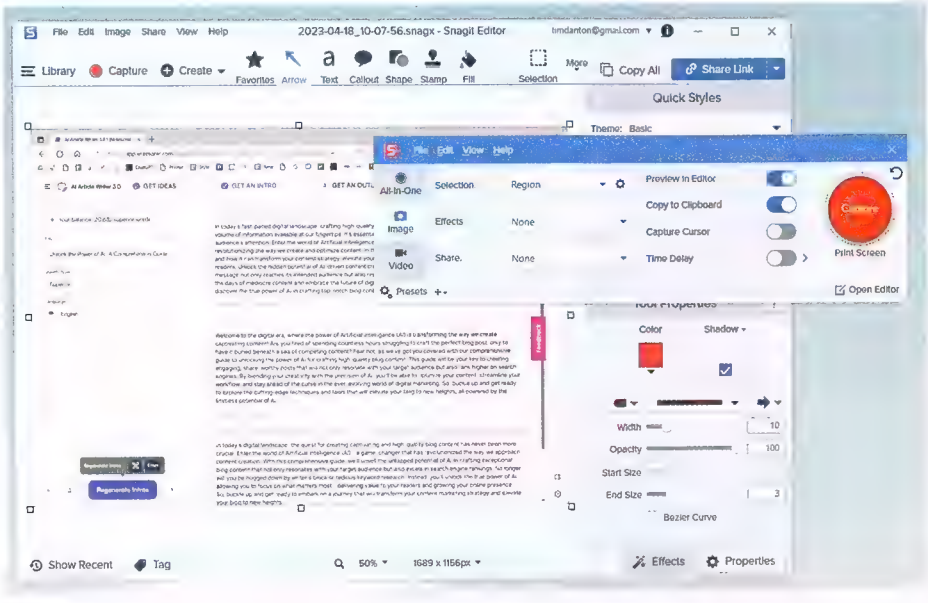
As Paul McCool pointed out to us, keyboard shortcuts "can take time to learn... but the time saved all adds up". We 100 percent agree, and as a starter for ten may we suggest adding Win-X to your armoury. This bypasses the usual graphical Windows interface so you can jump straight to, say, the Task Manager.

Touchpad gestures

If touching a keyboard is simply too much effort, here are four of our favourite touchpad gestures on Windows. Swipe down with three fingers: all your active windows disappear to reveal the desktop beneath. Swipe up with three fingers: all your open windows spring into action. You can also switch between open applications by swiping left/right with three fingers, or upgrade to master level and add a fourth finger – at which point you can switch between desktops.

Load up Power Automate

Power Automate could easily fill an article all on its own, as it's an extremely powerful tool – and not designed for beginners. But if you're comfortable with the language of coding then you may find that it saves you an immense amount of time, by automating workflows to the nth degree. It's built into Windows 11, but you may need to download the app from the Windows Store if you're running Windows 10. ■



SnagIt can produce "screenshots on steroids".

WE'RE ALL GOING ON A BUSMAN'S HOLIDAY!

PC simulations are growing amazingly realistic. We ask four professionals to play games in their field to find out how accurate they really are.

Read any review of a simulator and you'll find phrases such as "unbelievably realistic" thrown about by a jobbing journalist who has no idea what it's like to fly a plane, run a football club or drive a train.

Games such as Microsoft Flight Simulator might look like a facsimile of the real thing, but unless you've sat in the cockpit of a 737 and flown it over the Atlantic, your opinion on how close the experience is to real life is, frankly, irrelevant.

That's why we asked four highly trained professionals to play a selection of well-known simulators and tell us exactly how close to life these digital recreations are – starting with repair shop maestro, Lee Grant.

THE PC FIXER

LEE GRANT, PROFESSIONAL PC REPAIRER, PLAYS *PC BUILDING SIMULATOR 2*

PC Building Simulator 2 (PCBS2) puts you at the heart of a PC repair business, with customers clamouring for your services in return for hard cash. I was keen to see if it matched the reality of my experience of doing the same.

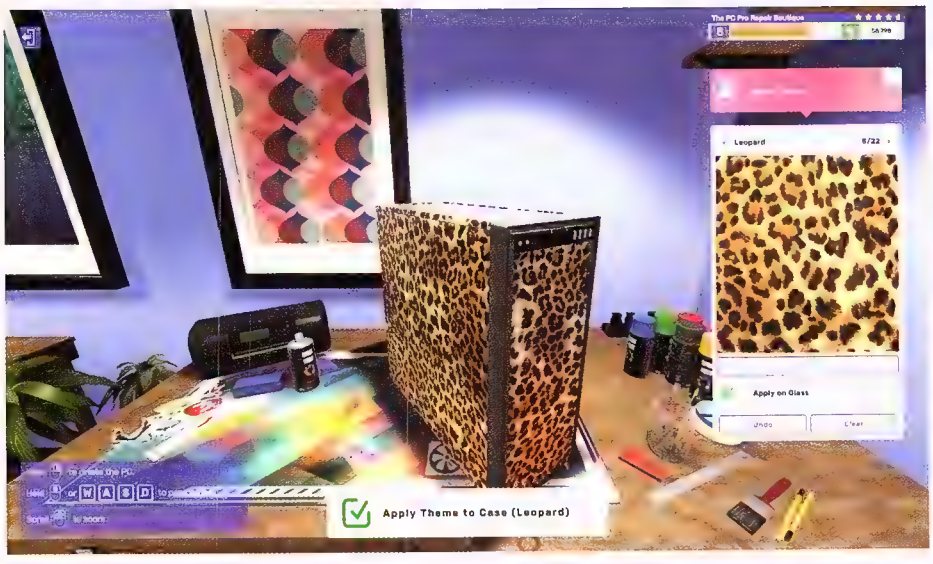
The *PCBS2* simulator is wrapped around a narrative that begins after you've inherited a PC repair shop from someone called, and I kid you not, Tim. This retail empire has two rooms packed with workbenches alongside a vast showroom with décor that looks like Tim hired them out as nuclear testing facilities.

Typically, the early stages of *PCBS2* are guided experiences, showing what and where to click in order to fix things. First on the bench is a virus cleanup, and *PCBS2* helps wire up the machine and boot it from a USB stick. A click on the handy Clean Virus app eradicates over 800 gremlins before the machine is powered down and put out for collection. In the real world, I'd have checked that the machine still booted, but *PCBS2* had already billed the customer $120 for this three-minute job, so perhaps I need to focus less on customer service and more on where I'm going to park my first crystal-encrusted Ferrari.

A large part of the *PCBS2* experience concerns computer hardware. The game's splash-screen is packed with the same big-brand logos featured in *APC*, and *PCBS2* has an impressive and ever-increasing range of over a thousand components to tinker with. The graphical reproduction is accurate, so bolting together a system in *PCBS2* creates a realistic facsimile of something you could build yourself.

Although the visuals enhance the verisimilitude of *PCBS2*, it also remains true to technical aspects of PC building. Matching incompatible components is hard, so trying to fit an AM4-sized Ryzen CPU into an Intel Socket 1200 motherboard isn't possible, but *PCBS2* also reacts when Coffee Lake, Skylake and Kaby Lake CPUs (all using the LGA 1151 socket) are slotted into mis-matched boards. As the game advances, players are punished for under-powered PSUs, incorrect RAM timings and unrealistic overclocks in much the same way that real hardware will bite back. As a simulator, *PCBS2* has much to commend it technically.

There are some bizarre story



elements associated with the retail aspects of the game. Early on, an email offer comes in from some bloke, offering to rejuvenate the store front and workshops. A day later, for no cash, the place looks like an Apple Store. Who paid for this and with what? Not this business certainly, as there's no form of taxation within the game to offset the vast profits *PCBS2* claims can be made by changing a knackered stick of RAM.

Customers also tell you what's ailing their machines with astonishing accuracy, but as you advance, other beginner-friendly elements continue. Suppliers never send dead components, and not only is everything always in stock, but it arrives the next day before the store opens. Customisation is a frequent task, and some of the best-paid jobs are to add stickers to a case or to spray everything yellow. Curiously, there are no laptops in *PCBS2* and any fix is instant, permanent, and no customer-aftercare is ever required. The most jarring omission relates to data, as it's possible to install a new SSD in a machine with nothing but an OS, and the customer never asks where their photos have gone.

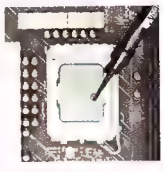
At its core, this game is about PC building, but some odd decisions have been made. All work is carried out with the machines upright, which is perfect if you want to bend pins, drop screws and fight against gravity. Failing to apply CPU compound on a cold CPU will also cause an instant blue screen. I love the game's Cable Fairy – which connects and rewires the machine with a few clicks, saving hours of real-world rewiring – but the Fairy appears to connect cables from the old PSU directly into the possibly incompatible replacement, which is a red flag. The ATX specification only standardises pin-out on the peripheral end and not within the PSU's sockets, so this may explain why Cable Fairy isn't commercially available.

A major revenue generator in the game is the buying and selling of second-hand gear from a man known, genuinely, as Baz. The aim here is to wang anything you have into a case to create a working machine, then flog it. The price goes up for tweaking LED lights, overclocking, water-cooling and even giving the machine a name. I sold a pretty grim machine for vast profits by calling it "Second Hand Crap".

PCBS2 is not only a game, but a sandbox, too. There's a mode without the narrative and all the components and tools are available. The aim here is to build the machine of your dreams, money no object. *PCBS2*'s great watercooling options (with no leaks, of course) allow for striking designs, complemented by the custom-cable builder introduced during the last update. A nice feature is to be able to share your design with others, so they can import it into their game and interact with the amazing machine you've created.

PCBS2 is a well-crafted game that I recommend to anyone wanting to learn how to build PCs. It does a lot of things well and many of the mumbles I've mentioned could be put down to making the simulator playable as, and don't tell anyone I said this, building PCs can be quite dull. Is it real? Well, it's a game about a PC repair technician who frequently interacts with two men called Tim and Baz. Seems suspiciously accurate to me.

ABOVE Giving a PC a snazzy makeover can generate huge profits.



ABOVE The graphics faithfully show the technical aspects of PC building.

BELOW Flight controls in the sim can be trickier than the real thing.

THE PILOT

GAVIN HALL, PILOT FOR ONE OF THE WORLD'S BIGGEST COMMERCIAL AIRLINES, PLAYS *MICROSOFT FLIGHT SIMULATOR*

If you were to compare *Microsoft Flight Simulator* to driving, it would be a game that does everything from driving an HGV all the way to Formula One cars. So it's a question of how realistically you can do that sitting at your desk at home.

The capability to have a very realistic sim is in there. But then the difficulty is that, the more complicated the aircraft, the more physical controls it will have. If I want to turn on a fuel pump in an aircraft, for example, I just look up to the overhead panel, reach up and press the button. In *Flight Simulator*, you have to faff about with controls to pan your view and then get the mouse and click it. So, basically, the more complicated the aircraft, the harder it becomes to simulate it accurately.

My first experience of flight simulators came when I was a kid playing with them. I was pretty terrible and I couldn't actually do anything properly. And then once I'd actually had flying lessons and I knew how to fly, I went back to the flight simulators and it was like "ah, that's how this works". So if you know what you're doing, then *Flight Simulator* works really well. But if you're starting from scratch and no-one tells you what to do, your chances of doing it correctly in the game are quite low.

I do have a joystick, but I've had it since *Flight Simulator 2004* came out. I've never really felt the desire to invest in the full setup because I'm doing it for a living. I know people who have taken a spare box room in their house and turned it into a full-on sim with all the other screens that you'd have in the airliner and overhead panels, but that's certainly not how I want to spend my time off!

It's not like you could get that close to the real thing anyway. It depends

LEFT Some aspects of *Flight Simulator* are on a par with commercial sims.

on how much time and effort you're willing to invest in in getting it right, of course, but you don't have the G-force sensation you'd have in the real world. You can start off with a $50 joystick or invest in something that costs into the thousands, but real-world controls in an actual aircraft are phenomenally expensive. I've yet to use anything in the consumer space that comes even close to the actual feel of a real-world control. Some are better than others, but you can still tell they're a few hundred dollars instead of tens of thousands of dollars.

The in-game weather definitely affects the aircraft – I can't really imagine how you would be able to make it any better, to be honest. I mean, I'm sure they'll say that there are new ways we could update the models, but from what I've seen, what's in *Flight Simulator* now is as good as what you would find in a commercial flight simulator.

On the flip side, air traffic control isn't brilliant. One of the interesting things about flying around the world is actually seeing what air traffic control is like in different places and how they do things differently. The base version of *Flight Simulator* just comes with a generic American ATC system that does things as the as Americans would.

But there are a lot of people who like to play *Flight Simulator* in a realistic air traffic control environment called Vatsim, and if you're taking part in that kind of world, you're expected to do things properly. And if you don't, you'll probably be asked to leave.

I don't know this for certain, but I was watching a friend of mine play with Vatsim a while ago and one of the voices I heard sounded like an actual air traffic controller I've heard on the radio. So, I'm not sure if the air traffic controllers are doing this busman's holiday thing in their spare time, but some of them were almost a bit too good.

LEFT The in-game weather affects the aircraft in a realistic fashion.

THE TUBE DRIVER

HENRY LUPTON, TRAIN DRIVER, PLAYS *TRAIN SIM WORLD 2*

I bought *Train Sim World 2* for my little boy, as he's obsessed with trains. That one has the Bakerloo line trains, which I've never driven, but the trains themselves are like a baby version of the C stock that I used to drive on the District line. So, weirdly, I know where everything is on the trains, even though I've never driven them myself.

The cab layout is as accurate as I think it could possibly be. All the switches seem to be in the right places. They're all labelled correctly. But the actual driving of it... it's sort of close, but sort of not.

If you come into the back of a platform at 50-plus kilometres per hour, you're on full brake in real life, not minimum braking and stopping halfway down. I did manage to force an overshoot, which is good, but I had to hit the back of a platform at 70 kilometres an hour and just say "bye bye" to it on the emergency brake, which is realistic, because you'd never stop in time on those trains! It slides around a bit in the wet and you get wheel spin, too.

But there are weird things to

THE FOOTBALL MANAGER

DALE HURLEY, FORMER MANAGER OF TWO ISTHMIAN LEAGUE FOOTBALL CLUBS, ON *FOOTBALL MANAGER 2023*

In *Football Manager*, there's lots of really good depth to what they do in terms of player conversations and contracts. There are promises that you can make to a player, and then you obviously have to follow them up, or if you don't follow them up clubs will come in for your player or players will come to you and say, "I want to move to XYZ club – what's it going to take for me to leave or what can you give me to make me stay?"

I've seen that in my real job. We had a player that wanted to leave and was offered more money elsewhere. We just talked him round, said these are the pros and cons of going, you've done really well for us, you've scored a lot of goals for us. If you have a little bit of experience of a conversation like that, what different outcomes they might come back to you with, it helps. The player ended up staying, even though he was offered more than twice as much money elsewhere.

Tactically, *Football Manager* is brilliant. The one thing that I don't

driving trains that aren't in the game, which you wouldn't know unless you actually drive them. Things such as the slight delay when you change something. So, if you apply brakes, there's a delay before the brakes come on. When you're driving manually, you're making adjustments based on what's going on, and track gradient can affect it, as well as weather conditions, and even the weight of the train can have a slight effect. You can get over 800 people on them.

The other thing that the game doesn't have is the mirrors and monitors. They don't work at all – they're just static images. So, wherever you stop, you can't see if people are getting on and off the train. I think that's because the game is designed for fun rather than being too serious, because obviously on a real train I need to see every set of doors. And if I can't see every set of doors, I have to do something about that before I can think about closing them.

Overall, I'd say it's fairly realistic. But being able to drive in the game and being able to drive a real train are two different things. I actually find it a little bit harder driving in the simulator, just because I can't feel the train. On the real train, I drive by eyeball and by feel rather than looking at the speedo as I'm coming down the platform, because I need to be watching what's happening. So, it's a little bit harder in that regards. And you could get away with things in the game you would never get away with on the train!

ABOVE RIGHT The mirrors and monitors don't work as they should. **ABOVE** The cab layout, however, is as accurate as it could possibly be.

like so much is that you have one structured formation. So, you have a 4-3-3, say, but that's both in possession and out of possession. In real life, my personal preference is to have a back four when we're out of possession and we have a back three when we're in possession, to get an extra body further up the pitch. That's something that doesn't happen in the game, although there probably is a way around it that I just haven't found.

In *Football Manager* there are loads of different player roles, such as ball-playing defender, no-nonsense defender and stuff like that, and you spend time trying to find players that suit those roles. When you're managing in real life, you often think "he's more of a no-nonsense defender, rather than a ball-player", so you can almost label players in real life in the same way you would in the game.

I've managed in non-league in real life and *Football Manager*. In the game, what you find out is they train twice a week like they would do in real life, but if your player hasn't played for four or five weeks in the game, their conditioning is really low. Whereas in real life, I feel like if you're missing out for five weeks, yes you might not be as sharp but they're doing enough to keep themselves ticking over, whereas in the game, they're dead, they can't play 90 minutes.

Is *Football Manager* better than real life? I don't think you can ever replicate the buzz of real management, fighting for three points or going on a cup run, but the game is good fun. In my recent save, I've got FC Edinburgh from the Scottish third tier to Club World Champions, so that was a buzz in itself and I'm quite happy with that one! ■

BELOW From the Scottish third tier to Club World Champions!

PART 1 OF 5
Don't miss next issue, subscribe on page 20!

Home computers in Australia

In this new multi-part series, ***Darren Yates*** *re-traces Australia's computing history during the golden age of the 'home computer' in the 1970s and 80s, starting with our unique dawn of DIY computers.*

Above: The Australian-designed MicroBee is well remembered as an education computer in NSW, but was first a DIY kit (Image credit: Bilby, CC BY 3.0).

Below: The prototype of the DREAM-6800 home computer (Image credit: Michael Bauer).

Australia has long had a reputation for punching above its weight in technological research and development. From the early days of radio to our pioneering involvement in radar to our world-class expertise in radio-astronomy, we've applied our ingenuity to our unique geographical requirements and shown the rest of the world a thing or two along the way. Even in the very early days of computing, Australia designed and built just the fourth stored-program computer in the world – the CSIR Mk I, better known as 'CSIRAC'. But it wasn't until the 1970s that computers began to find a place in the home – that gloriously golden era of the 'home computer' that began with the launch of the Apple II, Commodore PET and Tandy TRS-80 Model I in 1977.

Except, it didn't – not in Australia. Over the coming months, we'll look back at our unique story and some of the computers (some remembered, others forgotten) that made it such a golden age – an age, for us, that began a few years earlier in 1974.

Electronics first, computers second

By the early-1970s, electronics was still a hugely popular hobby in Australia. Since the dawn of 'wireless' in the 1920s, many of us tinkered with electronic valves and parts to build our own radios and then, when television arrived in Australia in 1956, we began building our own TVs as well.

While some hobbyists gained their training at university and many more at state-based TAFE colleges, a great deal of Australia's home-brew verve was fostered by local technical magazines.

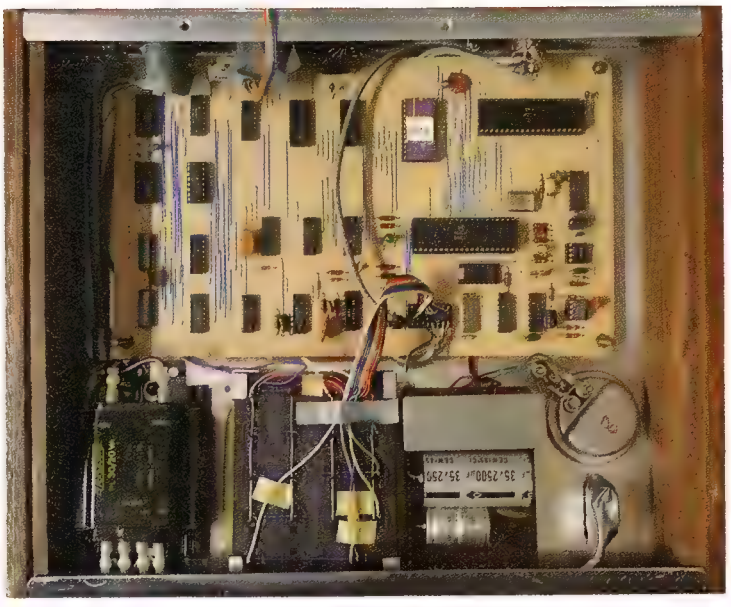
One of those magazines, now gone, was *Electronics Australia*, or 'EA' as it was known. It was a descendent of *Wireless Weekly*, Australia's first dedicated technology magazine launched in 1922 by Australia's first female electrical engineer, Violet McKenzie (we covered her story last year). During this same period, electronics magazines were also very popular in the U.S. and in the U.K.

The 1970s was the era of the digital integrated circuit or 'IC', silicon chips containing Boolean-logic functions you could wire up to do almost anything. Computers of the early-1970s featured hundreds of these chips and were now receiving the 'Hollywood' treatment, starring in movies including 1969's *The Italian Job*.

But in 1971, Intel developed the first microprocessor chip, the 4004, and although it didn't change the world instantly, it set in motion the development of computers as we know them today.

EDUC-8 (1974)

In fact, you can wander into a Coles supermarket today and buy a $59 computer masquerading as an



Left: Hobbyists could build the popular DREAM 6800 at home (Image credit: Michael Bauer).

Android phone, but back in 1974, computers were business tools, cabinet-sized and very expensive.

So, it was into that environment that 'Electronics Australia' published what was initially thought to be the world's first home-computer construction project in August 1974, called the 'EDUC-8'. This compact 8-bit computer was designed by Australian technology journalist and EA editor Jamieson (Jim) Rowe, describing it as a cut-down version of the famed Digital PDP-8 minicomputer he'd spent many hours programming. The EDUC-8 was unique in that it didn't have a microprocessor chip – they were still far too expensive in 1974 (more than a week's wages). Instead, it featured those now-common digital-logic chips, 96 of them to be precise.

The EDUC-8's specs were microscopically-tiny by today's standards - 32 bytes(!) of RAM and 500kHz (0.5MHz) clock speed. You programmed it by operating switches and read the results from the machine's LEDs. It sounds prehistoric today, but indeed, it was 'pre-history' – not even Microsoft (c. 1975) or Apple (c. 1976) yet existed, that's how revolutionary this little Aussie computer was!

Yet over the following months, the EDUC-8 grew to include an input/output (I/O) interface, external hexadecimal keypad and seven-segment display. A punched-paper tape reader followed, along with a printer and finally, a full ASCII keyboard in 1975. Like CSIRAC, it even learned to play simple music.

So why was it only 'initially thought' to be the world's first home computer? Sadly, just the month before, U.S. magazine 'Radio-Electronics' pipped EA at the post, publishing the 'Mark-8' computer.

But it didn't matter – the EDUC-8 lived up to its name to 'educate' anyone in the basics of computing, basics still valid today. It was also the computer you could make and repair yourself.

CHIP-8 programming language (1976)

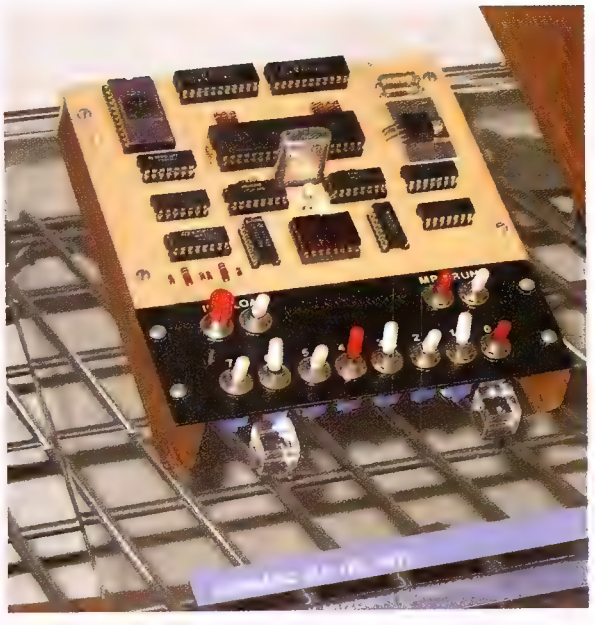
The mid-1970s saw a rapid build-up of building blocks that would spawn those three iconic home computers of 1977 – the Commodore PET, the Tandy TRS-80 and the Apple II. One of those blocks was the 6502 processor, launched by MOS Technology in 1975; another was the Z80 CPU released by Zilog in 1976. The key to these CPUs was price – MOS Technology sold the 6502 for just $25 each. In the end, Commodore and Apple chose the MOS 6502, while Tandy signed up for the Zilog Z80. With 8-bit microprocessors now available in quantity and at reasonable cost, the market exploded in 1977 and the rest is history.

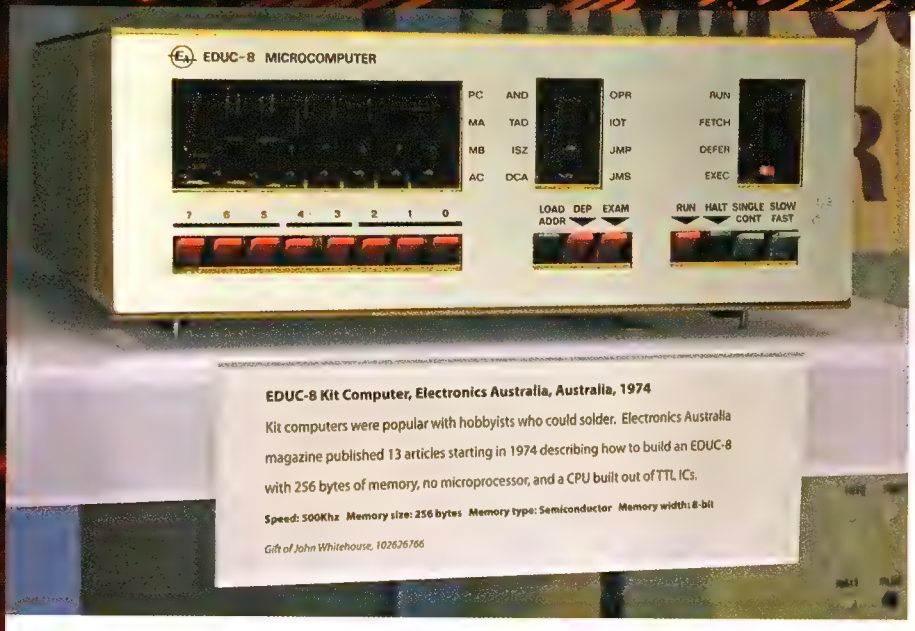
Nevertheless, the EDUC-8 got things rolling in Australia and interest in low-cost DIY computers ballooned globally well before events of 1977. One example was the COSMAC Elf, a DIY kit based on the equally-new RCA CDP1802 processor that appeared in the U.S. 'Popular Electronics' magazine in 1976. Like the EDUC-8, you programmed it using switches and read the output via LEDs. But the following year, the COSMAC VIP added a new 'video interface processor', giving it a TV-compatible output, along with a new 16-key hexadecimal (0-9, A-F) keypad. It was still primitive, but a now-familiar form was beginning to take shape.

You coded the VIP on its keypad using a brilliantly-simple programming language

Below: The COSMAC Elf, an early U.S. home computer featuring the CDP1802 CPU (Public Domain).

Above: I've designed a new 8-bit Arduino Nano-powered version of the DREAM 6800, here plugged into a 4.3-inch car LCD monitor (Image credit: Darren Yates).





Above: The EDUC-8, Australia's first home computer, designed by Australian tech editor Jim Rowe in 1974, on display at the Computer History Museum in California (Public Domain).

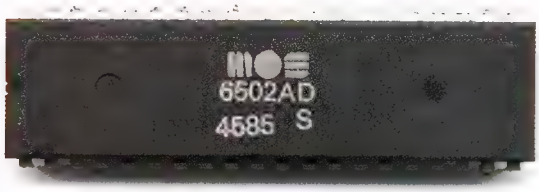
developed by Joe Weisbecker at RCA Labs called 'CHIP-8'. It had just 33 instructions, but was well suited to teach coding through computer games - many popular games including Space Invaders and Pac-man were ported to CHIP-8 using just those 36 instructions.

Mini Scamp (1977)

> "Australia's home computer pioneers weren't gamers or software gurus – they were electronics engineers and enthusiasts, people who saw the future and rather than wait for big flashy brands to turn up and sell them computers, they got on with it and built their own. That's the Australian way."

With Apple, Commodore and Tandy still some months away from getting their products on shelves, Australia launched another home computer project, this one designed by Dr. John Kennewell at NSW's University of Newcastle. Unlike the EDUC-8, the 'Mini Scamp' was the first Australian home-built computer to feature a genuine CPU, the SC/MP microprocessor from chipmaker National Semiconductor (now part of Texas Instruments).

Like the EDUC-8, the Mini Scamp featured switches and LEDs, with construction details published in 'Electronics Australia' starting in April 1977.



Below: The MOS Technology 6502 made many home computers possible (Image credit: Dirk Oppelt, CC BY-SA 3.0).

The following month, a young electronics entrepreneur, Dick Smith, began selling construction kits for the Mini Scamp.

DREAM 6800 (1979)

However, one of the first 8-bit CPUs to hit the market was the MC6800 ('6800') from U.S. tech giant Motorola in 1974 and by 1976, featured in a low-cost evaluation kit (an Arduino-style test board). Michael Bauer, a computer science tutor at Deakin University and electrical engineer, had one of these evaluation kits in 1978 and having seen the COSMAC VIP in a magazine, he was keen to make a VIP-alternative using the MC6800 instead. However, whereas the COSMAC VIP ran a video processor chip to create a U.S.-standard NTSC-video output, Bauer cleverly designed a PAL-standard video controller from discrete logic chips to support Australian TVs. The computer was known as the 'DREAM 6800'.

It, too, was published in EA, beginning in May 1979. My dad was one of many who saw this as the opportunity to delve into the computing world in an affordable way (the parts back then only cost around $100). He built one and the DREAM 6800 became my introduction to computing.

DREAM stood for 'Domestic Recreational and Educational Adaptive Microcomputer' and like the COSMAC, you coded the DREAM 6800 using CHIP-8 via the computer's hexadecimal keypad. It had 1KB of RAM and 64 x 32 monochrome (black-and-white) pixels, each one individually addressable. The 6800's clock speed was a spritely 4MHz and you could save programs to ordinary cassette tape using any cassette recorder (ideally one with a tape counter).

Above: The Color Maximite continues Australia's home computer tradition (Image credit: RSeverson, CC BY-SA 3.0).

The DREAM 6800 was an important step forward at the time – unlike the EDUC-8 and Mini Scamp, it combined keypad code-entry with tape storage and TV-video output all in the ready-to-build design.

Again, you might read '64 x 32 pixels' and question how this could be usable, but it was more than usable – it was life-changing. As a young kid, seeing a chunky pixel move across the TV screen for the first time because I programmed it is something I'll never forget.

ETI-660 (1981)

Australia began the 1980s with a number of electronics magazines, including chief EA-rival *Electronics Today International* (ETI). Not to be outdone by EA, ETI published a design beginning in May 1981 similar to the COSMAC VIP called the 'ETI-660' (ETI numbered their construction projects). It was designed by New Zealander Hugh Anderson, with help from ETI staffer Graeme Teesdale.

Like the DREAM 6800, you coded the ETI-660 using CHIP-8, but this one ran the original RCA CDP1802 processor rather than the Motorola 6800 yet incorporated Motorola's MC6821 I/O chip to handle the hexadecimal keypad. The ETI-660 also had improved audio, able to produce tones from 107Hz to 13,762Hz. The magazine continued publishing information about the ETI-660, including code-listings you typed in by hand, until 1984.

Dick Smith Super-80 (1981)

Still, you could argue that even by 1979, with the Apple II, Tandy TRS-80 and Commodore PET now available, the idea of entering code via a hexadecimal keypad, or even making your own computer, was getting past its use-by date. However, with the right skills,

those DIY models were still a much-valued, affordable way into computing.

The competition between electronics magazines in Australia peaked in the 1980s and while ETI published its ETI-660 with its hex-keypad, Electronics Australia joined forces with well-known retailer Dick Smith Electronics to launch the 'Dick Smith Super-80' in August 1981. Unlike the DIY computers to-date, the Super-80 was a computer kit enough to give the Tandy TRS-80 and newly-arrived Commodore VIC-20 a run for their money.

It was based around the popular Zilog Z80 8-bit CPU running at 2MHz, with 16KB of RAM (expandable to 48KB) and used cassette tape for tape storage. Again, by today's standards, the display (32x16-characters) was rudimentary, but in comparison, the Commodore VIC-20 only had 5KB of RAM and 22x23-character display, so the Super-80 was a winner for its then-$290 price tag.

What set it apart from many kit computers of the time was its full-travel ASCII keyboard and ability to run BASIC programs. Many developers today might nervously-twitch at the thought of BASIC programming, but in the era, BASIC was a launch pad for many future software engineers. Within a year, more than 2,000 Super-80s had been built – and it wouldn't be the last of Dick Smith's forays into home computing...

MicroBee (1982)

But Australia wasn't done with kit-built computers and in 1982, one of the most iconic Australian computers was released first as a kit, then quickly as a pre-assembled system – the MicroBee. Another of the growing cache of Z80 CPU-powered models, the MicroBee was the brainchild of Australians Owen Hill and Matthew Starr working at Applied Technology, with construction details of the kit version published in 'Your Computer' magazine. The standout for Microbee was winning a tender with the NSW Department of Education for an education computer, making the 'Bee (we believe) the first Australian design to do so. The improved version arrived the following year, upping the clock speed from 2MHz to 3.375MHz with a high-resolution 80-character x 24-line display.

The company survived the mid-80s global crash, but the last manufactured design arrived in 1987. Unfortunately, MicroBee couldn't hold off the might of U.S. competitors forever and by 1992, both it and the company were gone. However, in 2012, it resurfaced as MicroBee Technology and plans are afoot to reboot the classic MicroBee kit computer. At time of writing, a prototype was in progress but no launch date just yet.

DIY computing today

There were many others we don't have space to include, but today, DIY computing continues, thanks to Arduino, with dozens of microcontroller boards now available, often with similar amounts of RAM to the DREAM 6800 and VIC-20, able to interface with sensors and displays – and your PC.

But the 'home computer' era lives on through the likes of the excellent 'Maximite' computers first developed by Australian engineer Geoff Graham (**https://geoffg.net/maximite.html**). These new designs incorporate modern electronics, VGA-resolution colour graphics and program storage on SD card, but are still coded using BASIC. You'll see them reviewed on YouTube by 'The 8-bit Guy' (**youtube.com/watch?v=IA7REQxohV4**).

As for CHIP-8, Joe Weisbecker's famous programming language is still around today, teaching computer architecture and science. It's been expanded and seemingly ported to every computing device ever built - you'll find plenty of resources at **https://chip-8.github.io/links/**.

Leading the world

Australia's home computer pioneers weren't gamers or software gurus – they were electronics engineers and enthusiasts, people who saw the future and rather than wait for big flashy brands to turn up and sell them computers, they got on with it and built their own. That's the Australian way.

Nevertheless, there'd be no denying the march of time or the market's push to arm consumers with home computers ready to play pre-coded games and even try handling the family budget.

Next time, we look at Australia's early computer retail market and the electronics entrepreneur who gave us our own local alternatives to the Commodore VIC-20 and Tandy TRS-80. See you then. ■

Above: The COSMAC VIP featured a hex-keypad and output to a TV screen (Image credit: Dave Ruske, CC BY 2.0)

Left: The Dick Smith Super-80 had more RAM than a Commodore VIC-20 and over 2,000 were built in the first year (Image credit: GFHandel, CC BY-SA 3.0).

STOP USING WINDOWS TOOLS

Why stick with the tools that come with Windows when superior alternatives are available? Robert Irvine reveals the best free programs to replace Microsoft's default apps.

Windows offers pretty good value for money - especially when you can upgrade for free from the previous version. As well as the main operating system, you get plenty of extra apps and tools for performing everyday tasks, so you don't need to waste time downloading programs when you first set up your PC.

However, there's no reason you should stick with these default tools forever just because they're convenient to use. Some of the features built into Windows haven't been updated for years, which means they're starting to show their age, and virtually every tool installed by Microsoft has a superior alternative you can download for free.

In this feature, we recommend the best free software to replace 16 tools that come with Windows 10 and 11. Our carefully selected programs let you do much more than Microsoft's default apps, offering extra features, faster performance and greater flexibility in how you use them.

Also, in light of the recently discovered security flaw in Snipping Tool (see next page), they're less likely to be targeted by hackers.

We haven't included Edge in our suggestions for what to ditch, because deciding which browser to switch to is a feature article in itself, but our choices cover loads of other tools you use every day – but shouldn't any more.

THE 16 WINDOWS TOOLS YOU SHOULD STOP USING

1 Snipping Tool
2 File Explorer
3 Windows Search
4 Windows Run
5 Task Manager
6 Registry Editor
7 Disk Clean-up
8 Start
9 Paint
10 Microsoft Photos
11 Media Player
12 Notepad
13 Mail
14 Device Manager
15 System Information
16 Disk Management

REPLACE THESE CLASSIC WINDOWS TOOLS

1 Snipping Tool

In what's been dubbed the 'aCropalypse', a security flaw was recently discovered in Windows 11's Snipping Tool and 'Snip & Sketch' in Windows 10 that allows other people to see parts of a screenshot that you've cropped out. In a worst-case scenario the bug could enable someone to see sensitive information you thought you'd removed from an image, such as bank-account details.

Microsoft has issued an emergency patch to fix the vulnerability, which it described as 'Low severity' because "successful exploitation requires uncommon user interaction and several factors outside of an attacker's control" (**www.snipca.com/45645**). However, the flaw may still make you think twice about using Snipping Tool or 'Snip & Sketch' to capture and edit screenshots, especially when superior free tools are available.

WHAT TO USE INSTEAD

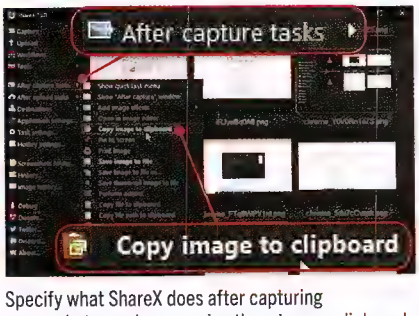
ShareX

getsharex.com

ShareX is an excellent free, open-source screen-capture tool that does everything Snipping Tool can – including recording videos – and much more besides. Although its interface looks a little confusing at first, dig into the program's menus and you'll find a host of useful options for capturing, annotating and sharing screenshots.

You can choose to capture specific windows, areas or your entire screen; blur and pixelate sensitive information or delete it using ShareX's Smart Eraser tool; automatically upload screenshots to online-storage services including Google Drive, OneDrive and Google Photos; and save image and video content in a range of formats including PNG, JPEG, TIFF, GIF and MP4.

ShareX lets you take screenshots using the hotkeys (keyboard shortcuts) of your choice, and specify which action it performs after capturing grabs, such as copying the result to your clipboard (see screenshot below left), opening it in an image editor or using OCR to extract text. Annotation options include drawing on screenshots with lines, shapes and arrows; adding text, step numbers and speech bubbles; and highlighting important elements in different colours.



Specify what ShareX does after capturing screenshots, such as copying them to your clipboard.

ShareX's versatility puts Snipping Tool and 'Snip & Sketch' to shame, but for a simpler alternative consider Greenshot (**getgreenshot.org**) instead. This free program has a handy Obfuscate option for concealing private data, but it hasn't been updated since 2017.

2 File Explorer

When Microsoft updated File Explorer last year to give it a long-awaited tabbed interface, we thought it was finally giving this essential system tool the attention it deserved. However, the change only applied to File Explorer in Windows 11 – as will upcoming improvements including a new Home button and Gallery view, and less-welcome additions such as 'recommended content' – so Windows 10 users don't get the benefit.

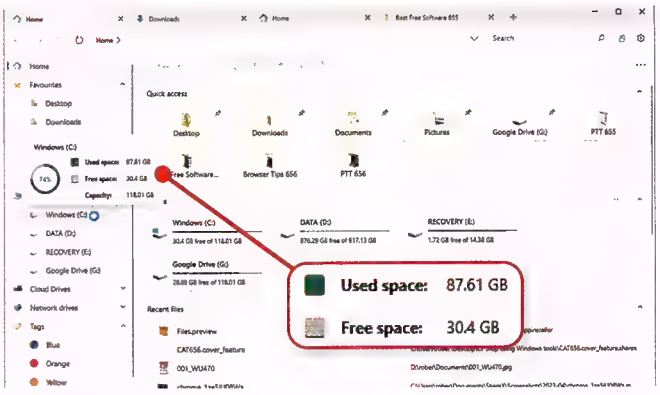
Although Windows 11 users can now open folders in tabs to easily switch between them, File Explorer is still pretty basic. By removing the ribbon toolbar, Microsoft was clearly trying to make the tool easier to use, but it actually achieved the opposite effect, forcing you to hunt for options that were once just a click away.

WHAT TO USE INSTEAD

Files

files.community

Files is the file manager that Files Explorer could be if Microsoft made more effort. This fantastic free program packs lots of useful features into an attractive interface that makes working with multiple files and folders as simple as possible.



Files makes it easy to manage multiple files, folders and drives, and see available space.

As well as opening folders in new tabs, you can switch between grid, column and tile layouts – or choose Adaptive to adjust the layout to suit the type of files you're viewing. You can sort items by name, size, type, date modified and date created; and easily select multiple files by ticking the boxes in their top-left corners, rather than holding down Ctrl. Files also lets you organise items by labelling them with coloured tags, so for example you can mark documents that need attention as orange and completed files as green.

Click the Settings cog in the top-right corner of the program window to access further options. These include a dark mode to reduce eye strain at night, a choice of tinted backgrounds and a 'Calculate folder sizes' setting that shows you the size of a folder when you hover your cursor over its icon. You can also see how much space is used and available on a partition or drive (see screenshot above).

To set Files as your default file manager instead of File Explorer, click Advanced in the Settings window and switch on 'Set Files as the default file manager'. Note that this feature is still 'experimental'.

Make sure you click the 'classic installer' link to download Files for free, because if you get the app from the Microsoft Store it will cost you $8.99.

3 Windows Search

The search tool built into the taskbar in Windows 10 and 11 is notoriously poor, especially at finding documents, photos and other files stored on your hard drive. It's slow, inaccurate and often yields no results for your search queries, even when you know that matches exist. Switching on Enhanced indexing in the Settings app can help speed up searches, but it also takes time and system resources to compile and update the index.

Rather than improve the desktop search facility In Windows 11, Microsoft has instead focused on adding web-search options that use its

search engine Bing, and recently integrated its new AI-powered Bing Chat tool. Although these additions save you having to open your browser to get online information, they're not much use for searching your PC. Windows Search is good at locating Windows tools and settings, but as a file finder it leaves a lot to be desired.

WHAT TO USE INSTEAD

Everything

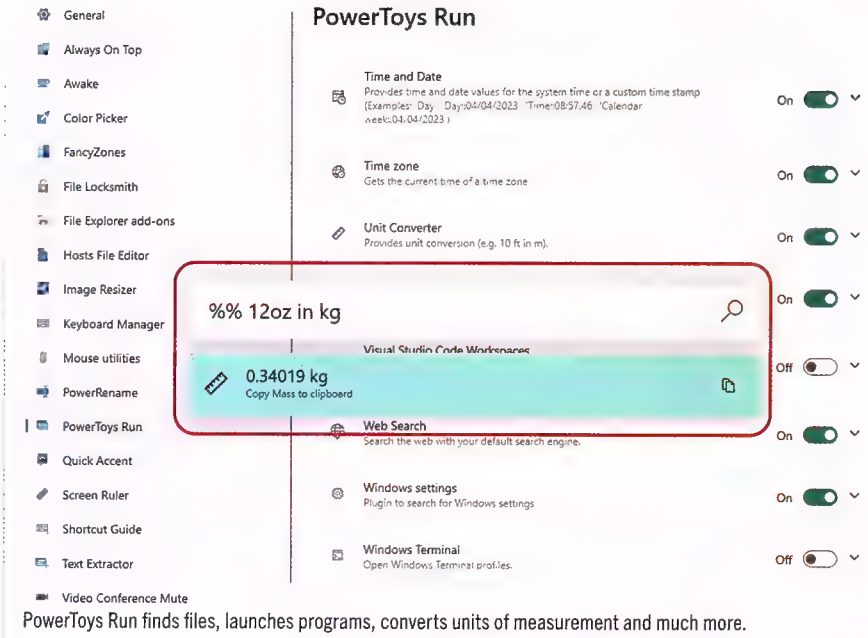
www.voidtools.com

Everything is the search tool that Windows badly needs – it's fast, accurate and easy to use, and concentrates on local searches rather than unnecessary web ones. It quickly indexes all the files and folders on your hard drive so you can find documents, photos and other items simply by typing part of their names into its search box.

Results appear almost instantly and can be sorted by file type, size, date created and modified, and other attributes by clicking the View menu and choosing 'Sort by' (see screenshot below). You can also choose to view thumbnail previews of each item and create your own search filters for more precise searches.

To add an Everything search box to the Windows taskbar, install EverythingToolbar (**github.com/srwi/EverythingToolbar**) open its Preferences and choose 'Replace start menu search box'. Alternatively, just click the magnifying-glass icon to launch Everything.

To optimise its performance, Everything doesn't index the text within files, but if you want to search file contents as well, we recommend the portable version of DocFetcher (**docfetcher.sourceforge.net/en/index.html**). This indexes Office file formats including DOCX, XLS and RTF, as well as PDF, EPUB and HTML files, and the metadata of MP3 and JPEG files. It takes a while to create its initial indexes, but you can speed things up by limiting its searches to specific drives or folders.



PowerToys Run finds files, launches programs, converts units of measurement and much more.

4 Windows Run

The Run command, which you launch by pressing Windows key-R or right-clicking the Start button and choosing Run, has been around since Windows 95 and is definitely showing its age.

It offers a simple way to open programs, system tools, websites and folders, but it's very basic and slow, and hasn't significantly changed since it was introduced. There's a sense that Microsoft only keeps the tool in Windows because long-time Run users would be outraged if it was removed, so the company instead keeps it effectively tucked away.

WHAT TO USE INSTEAD

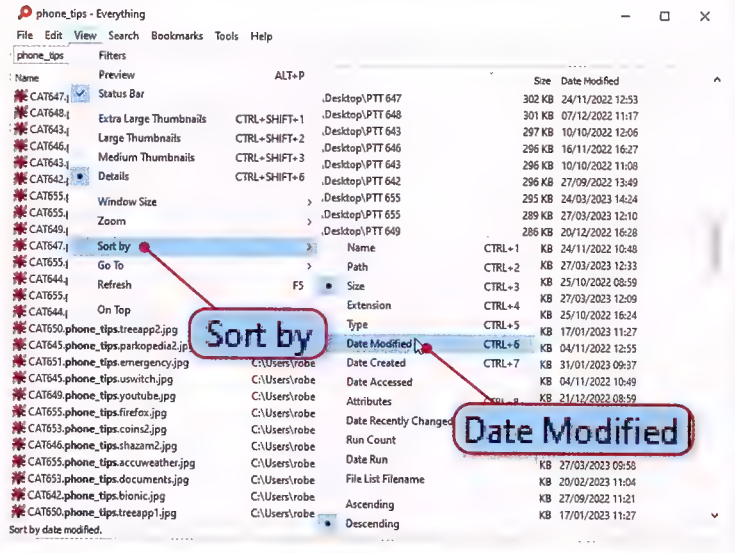
PowerToys Run

The best free alternative to Run comes from Microsoft itself in the form of PowerToys Run. This is available as part of the superb PowerToys system-utility suite (**github.com/microsoft/PowerToys**), and – once enabled – can be launched by pressing Alt-Space or by clicking the PowerToys icon in your system tray and selecting its shortcut.

It serves as both a speedy search tool for finding files, folders, browser bookmarks and more; and a launcher for opening programs, settings and registry keys. However, it's the optional plug-ins that make PowerToys Run really useful.

These are enabled through its Settings page and include options to perform mathematical calculations; convert units of measurement (see screenshot above); check the time in different countries; restart and shut down your PC, and lots more. You simply type an activation command, such as %% for unit conversions, followed by your query and PowerToys Run will give you an instant answer. See **learn.microsoft.com/en-us/windows/powertoys/run** for more details.

For a more lightweight solution, which doesn't require downloading a whole suite of tools, we recommend Listary (**www.listary.com**). This free tool also combines file-search and program-launching options, and lets you create custom commands, though some features are limited to a paid-for Pro version that costs US$19.95.



Everything offers a much faster way to find files than the Windows search tool.

5 Task Manager

One of the most baffling decisions Microsoft made in Windows 11 was to remove the option to launch Task Manager directly from the taskbar, which suggested it no longer thought the tool was important. Thankfully, this was rectified with the 22H2 update last year and Task Manager was also redesigned with some new features, including a search box for finding specific processes, a dark mode and an 'Efficiency mode' that prevents programs from hogging system resources.

Sadly, Windows 10 users haven't received any of these improvements and while Windows 11's Task Manager looks smarter and offers more options than before, it still doesn't provide much information about individual processes.

WHAT TO USE INSTEAD

Process Explorer

www.snipca.com/45601

Process Explorer is Microsoft's alternative Task Manager for power users, which provides a wealth of useful options for managing and viewing information about PC processes.

It colour-codes processes so you can see which are essential system services, third-party tools and new items, and which recently added a dark mode – click Options, then Theme to activate this. Right-clicking a process lets you free up memory and CPU power, and you can drag the crosshairs icon from the toolbar to a locked file to find out which process is locking it.

Process Explorer also lets you check if an unknown process is suspicious by using the malware-analysis service VirusTotal. Open the Options menu and select 'Check VirusTotal.com' to add a new VirusTotal column to the program (see screenshot below) that shows you how many antivirus engines detect the process as malicious.

You can set Process Explorer as your default Windows task manager by clicking Options, Replace Task Manager, then choosing Yes to confirm. It will then open when you press Ctrl-Shift-Esc or right-click the taskbar and choose Task Manager.

6 Registry Editor

Considering how integral the registry is to Windows – providing a massive database of configuration settings for your hardware, software, preferences, profiles and more – it's surprising that Microsoft has never made the Registry Editor easier to use. Presumably this is to deter less tech-savvy people from tweaking settings that mess up their PCs, but for those of us who like to customise Windows by editing registry keys, it's a shame that 'regedit' remains as fiddly and slow as ever.

WHAT TO USE INSTEAD

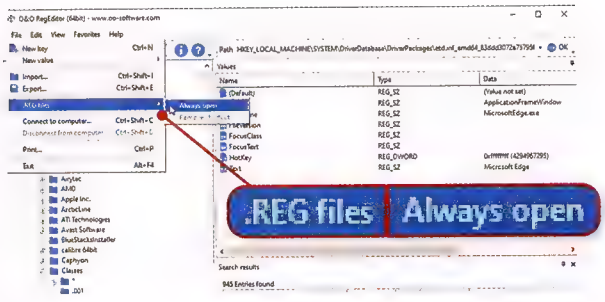
O&O RegEditor

www.oo-software.com/en/ooregeditor

O&O RegEditor offers a simpler and faster way to browse and edit the registry than Registry Editor. It has the same 'tree branch' structure, but offers lots of extra features.

Options include the ability to copy, paste, import and export registry keys; save frequently used keys as 'favourites'; and a speedy search tool that helps you find, edit and delete keys and values without needing to open lots of branches first.

O&O RegEditor is portable, so doesn't require installation, but you can set it as your default registry editor by clicking its File menu and choosing 'Always open' next to '.REG files' (see screenshot above).



O&O RegEditor makes browsing and searching the Windows registry straightforward.

7 Disk Cleanup

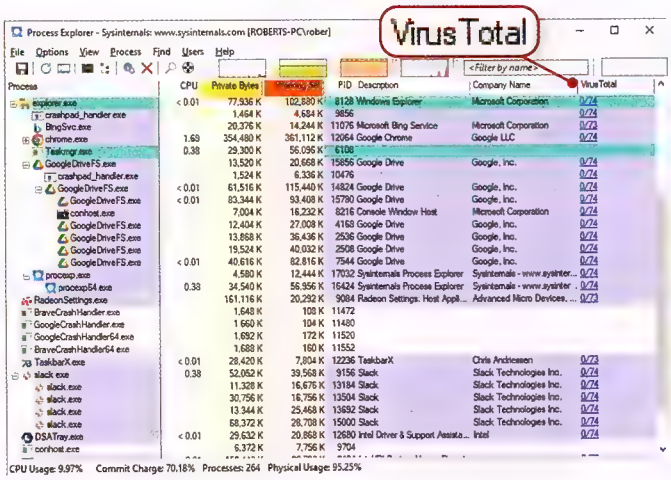
Microsoft has been threatening to remove its Disk Cleanup tool since 2018, in favour of the Storage Sense feature in Windows 10 and 11. However, it's still available in the latest versions of both operating systems – possibly because many users prefer removing junk with the old clean-up tool to configuring Storage Sense's settings. Fortunately, Microsoft now offers a new way to clean up and speed up your PC that combines the best options from both methods.

WHAT TO USE INSTEAD

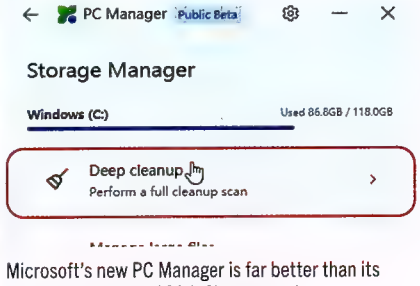
Microsoft PC Manager

pcmanager-en.microsoft.com

Although PC Manager is still in beta, it provides a fast and effective way to remove junk files and space hogs from your PC. Click the Cleanup tab, choose 'Health check' and the tool will quickly detect unnecessary items on your hard drive, including temporary files and cached data. Click 'Proceed' to delete these junk files, then choose 'Storage management' and select 'Deep cleanup' (see screenshot below). This performs a more thorough scan for files that can be removed to free up space, including old Windows updates and Microsoft Defender logs. You can also delete large files that are eating into storage, and automatically clean up junk files – though this option still relies on Storage Sense.



Process Explorer uses VirusTotal to reveal whether active processes on your PC are potentially dangerous.



Microsoft's new PC Manager is far better than its classic but outdated Disk Cleanup tool.

8 Start

No Windows feature has suffered more from Microsoft's meddling than the Start menu. Scrapped in Windows 8 (then restored in 8.1), bloated with 'live tiles' in Windows 10, then relocated and 'reimagined' in Windows 11 – and soon to display adverts in the form of 'notifications' (**www.snipca.com/45605**). It's a tool we'd gladly stop using, if it weren't so important.

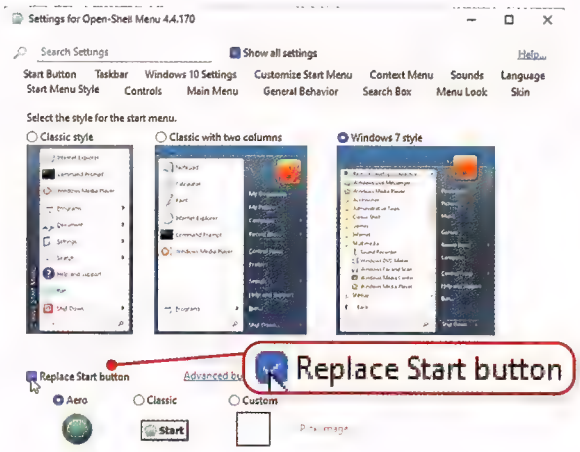
Because the Start menu is your main means of accessing programs and turning off and restarting your PC, it would be unwise to remove it even if that were possible, so instead it's better to find a replacement.

WHAT TO USE INSTEAD

Open-Shell

www.snipca.com/45606

Unlike most Start-menu alternatives, Open-Shell is completely free to use. In Windows 10, it automatically changes your Start menu to a classic, compact list that gives you easy access to your programs, recent items, Windows settings, shutdown options and more. Right-click the Start button and choose Settings to apply different skins (themes), such as Metallic, Midnight and Windows Aero, and different Start-menu styles, including the old Windows 7 layout.



Open-Shell restores the Windows Start menu to its traditional location and appearance.

In Windows 11, because Microsoft has placed the Weather widget where the Start button used to be, you need to open Open-Shell's Menu Settings first. On the Start Menu Style tab, select 'Replace Start button' (see screenshot) and choose your preferred button design, before you customise the menu's appearance. You can then launch your new menu by clicking OpenShell's Start button or press the Windows key to open the Windows 11 Start menu. To hide the Weather widget, right-click the taskbar, choose 'Taskbar settings' and switch off Widgets.

You can get a traditional Start menu and taskbar in Windows 11 by installing StartAllBack (**www.startallback.com**). This program moves taskbar icons to the left of your screen, so the Start button appears in its familiar position, and applies a Windows 7-style layout to your Start menu, including a search box. If you prefer, you can choose its 'Proper 11' theme to retain Windows 11's rounded corners and colour scheme.

StartAllBack costs $4.99, but this is a one-off purchase – there's also a Windows 10 version called StartIsBack (**www.startisback.com**).

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STOP USING PREINSTALLED WINDOWS APPS

9 Paint

Many Windows users are very fond of Paint, as Microsoft discovered in 2019 when it faced a backlash for planning to remove the graphics program from Windows 10. It changed its mind and also made Paint available as a Microsoft Store app. An updated version is available in Windows 11, while its successor – the less popular Paint 3D – is still installed on many PCs.

Although it's handy to have a simple tool to hand for basic image edits and artistic doodles, there are better free options than Paint, albeit without the accompanying sense of nostalgia. Even the Windows 11 app only has a tiny set of tools, and its brushes and shapes are geared more towards touchscreens than mouse work.

WHAT TO USE INSTEAD

Paint.NET

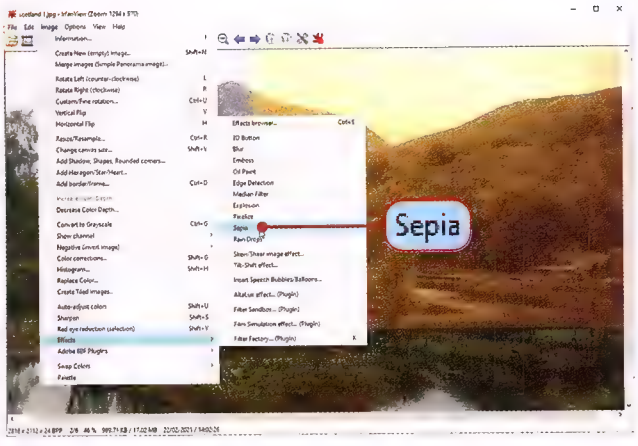
getpaint.net/index.html

As Paint.NET was conceived as an advanced replacement for Paint, it's the most obvious free alternative, and version 5 of the program – released in January – makes it too good to ignore.

This major update switches to using your PC's graphic processor to make the software faster, and adds a host of effects and adjustments that previously required you to install plug-ins. These include a Bokeh effect that lets you blur the background of photos while keeping the subject in focus. Paint.NET has also added 'pressure sensitivity', which lets you draw with natural-looking brush strokes using a stylus pen or graphics tablet.

It's a much more sophisticated program than Paint, but it's still simpler than the likes of Photoshop and GIMP, especially when working with Layers (see screenshot below left), which let you 'paint' complex images by stacking multiple elements.

Make sure you download the desktop program rather than the Microsoft Store app, as the latter costs $14.95.



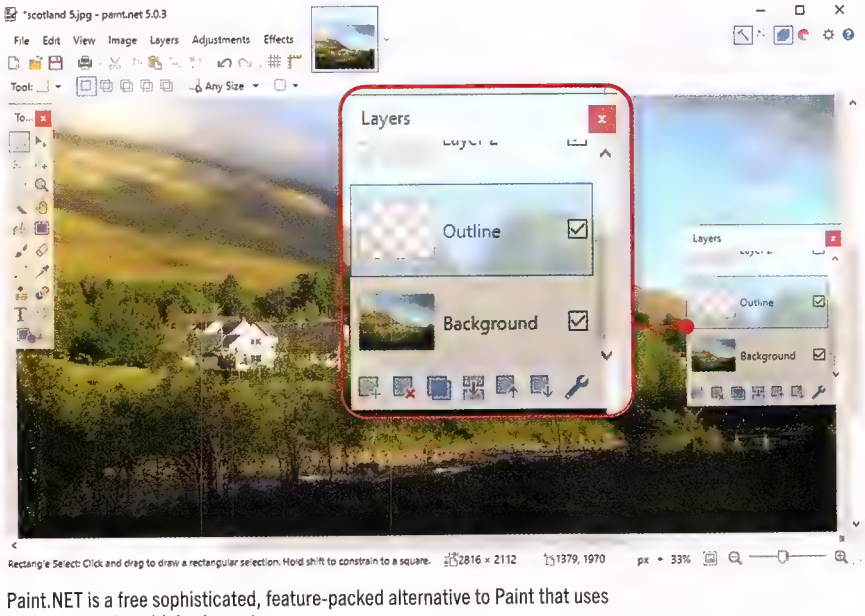
IrfanView offers a speedy way to view and edit your photos and includes effects such as Sepia

10 Microsoft Photos

Like Paint, the Photos app in Windows is great for simple tasks such as viewing, organising and performing basic edits to your pictures, and also offers filters and adjustments, including red-eye removal.

In Windows 10, it includes a video editor, which lets you turn your photos into short films, complete with captions, music and 3D effects. This feature has been dropped in Windows 11, with video-editing moved to Microsoft's Clipchamp app and more emphasis now placed on viewing images.

Sadly, both versions are slow and use a lot of resources, and though some users may find the integration with OneDrive useful, it's also rather pushy on Microsoft's part.



Paint.NET is a free sophisticated, feature-packed alternative to Paint that uses Layers to stack multiple elements.

WHAT TO USE INSTEAD

IrfanView

www.irfanview.com

For a lightweight image viewer that also offers lots of editing options, it's hard to beat IrfanView. This versatile free program is speedy to use, lets you convert and rename large batches of photos in one go and – unlike Photos – presents all its tools in logically organised menus so they're only ever a couple of clicks away.

Options include colour correction, frames, red-eye reduction, watermark and effects such as Blur, Oil Paint, Sepia (see screenshot above right) and Insert Speech Bubbles. Many more are available by installing the Plugins pack from **www.irfanview.com/plugins.htm**. You can also run IrfanView from a USB stick to edit your photos wherever you go.

For an even simpler solution in a more Photos-like interface, we like the new Icecream Photo Editor (**icecreamapps.com/Photo-Editor**).

11 Media Player

After burying Windows Media Player (WMP) in Windows 10 (it's no longer listed in the Start menu, but is still installed if you search for it), Microsoft has now revived it in Windows 11 to replace the little-loved Groove Music app. However, the new app is nothing to get excited about. Although its interface looks clean and modern, it lacks most of the features that made the old WMP appealing, such as skins and visualisations, and is slow to import audio and video files. The only interesting new feature is the ability to play and rip audio CDs, which the Windows 7-era Media Player did anyway.

WHAT TO USE INSTEAD

SMPlayer

www.smplayer.info

VLC Media Player is the most popular free alternative to Windows Media Player, but SMPlayer is just as powerful and uses fewer system resources than either of those programs. It can play virtually all video and audio formats, including CDs, DVDs and Blu-rays, without needing any extra codecs, and can also stream content over the internet.

SMPlayer includes an equaliser and audio filters, so you can get the sound of your media playback just right; options for adjusting the playback speed, importing subtitles and grabbing screenshots from films; and the ability to bookmark long files so you can jump straight to specific moments. It can also be customised with a choice of attractive skins.

Best of all, SMPlayer offers a YouTube browser that lets you watch videos on the service without opening your browser. Download and install the SMTube plug-in (**www.smtube.org**), then click View and select 'YouTube browser' (see screenshot right) to search for a video. Click 'Proceed' to link the program with YouTube, and play the selected clip.

SMPlayer supports nearly all media formats and lets you browse and watch YouTube videos.

Sea waves & beach drone video Free HD Video - no copyright.mp4 - SMPlayer
Open Play Video Audio Subtitles Browse Options Help
Information and properties... Ctrl+I
Playlist Ctrl+L
YouTube™ browser F11
OSD
Logs
MPlayer/mpv log Ctrl+M
SMPlayer log Ctrl+S
Information about connected screens
YouTube™ browser
00:00:01 / 00:03:21

12 Notepad

There's nothing really wrong with Notepad, the simple text editor that first appeared in MS-DOS in 1983 and has been in every version of Windows since. Indeed, it's one of the rare examples of Microsoft adopting an 'if it ain't broke, don't fix it' approach. Even the Windows 11 redesign has improved rather than ruined the app by adding a new dark mode, multi-step Undo function and tabbed browsing, as well as combining the View and Format menus. However, envious Windows 10 users – and Windows 11 users seeking more options – should consider the following alternative.

WHAT TO USE INSTEAD

Notepad++

notepad-plus-plus.org

Notepad++ has long offered tabbed browsing and a dark mode, along with dozens of other useful features. It's primarily aimed at programmers, and its interface initially looks intimidating, but you'll soon find it a much more flexible way to take notes than traditional Notepad.

For example, the left-hand sidebar numbers each line of text and lets you mark the most important lines with a small blue circle. This allows you to delete unnecessary content by right-clicking the sidebar and choosing Remove Non- Bookmarked Lines. You can look up words online by highlighting them, right-clicking and selecting 'Search on Internet' (see screenshot below); auto- complete commonly used words and phrases by switching on Auto-completion in the Edit menu; automate tasks by creating macros; find and replace words across multiple documents; and add even more features by installing plug-ins.

To make Notepad++ look simpler, you can hide its toolbar. Click the Settings menu, choose Preferences then General and tick Hide in the Toolbar section.

13 Mail

The built-in Mail app in Windows 10 and 11 suffers from being both basic and bloated, which means you have to wait for it to load but then can't do much with it. For example, there's no option to create rules to filter messages into specific folders; you can't send emails in plain text; and clicking 'Switch to calendar' opens the separate Calendar app, which is also slow to load. It's no wonder Microsoft is now encouraging Windows users to try its new Outlook app, which will be free to use when it launches soon, unlike the previous Microsoft 365 version - rather than stick with Mail.

WHAT TO USE INSTEAD

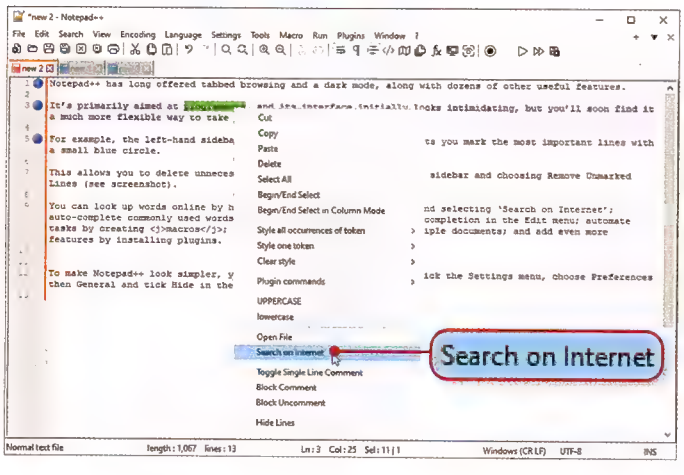
Thunderbird

www.thunderbird.net

Since it was redesigned last year, Thunderbird has been our favourite free email client, combining the simplicity of a webmail service with the features of a desktop program. You can import your messages and contacts from Gmail, Outlook and other providers; switch between multiple emails using tabbed browsing; and find messages easily by typing words into the Quick Filter search box.

As well as offering reliable junk-mail filters, Thunderbird protects you against phishing scams and blocks hidden trackers in emails. It lets you send large files faster by sharing them through your preferred online storage service and customise how it looks and works by adjusting its layout, applying themes and installing hundreds of add-ons.

Unlike the Windows Mail app, Thunderbird's calendar is fully integrated with the program and it's constantly being updated with new features. Also, in contrast to Microsoft's new Outlook app, it doesn't display ads in your inbox – or anywhere else.



Notepad++ includes everything you get in Notepad and dozens of other useful features.

DITCH THESE WINDOWS SYSTEM TOOLS

14 Device Manager

Device Manager is an important Windows tool that's hampered by being tucked away and by its old-fashioned tree-branch structure – it looks exactly the same in Windows 11 as it did in Windows 98. If only there was a faster way to access information about the devices connected to your PC.

WHAT TO USE INSTEAD

DevManView

www.snipca.com/45624

DevManView from the prolific developer NirSoft shows Microsoft how it's done, by listing all your connected hardware in a flat list instead of a tree view. Double-click a device to view information including the date and time it was installed and last used. Right-click it for useful options such as disabling, enabling and uninstalling the device; navigating to the relevant registry key; and performing a Google search for its name (see screenshot below). Provided you run DevManView as an administrator, you can also check the device lists of other computers on your network.

15 System Information

Boring but useful, the System Information tool provides details of your hardware configuration and components in the driest manner imaginable – long lists that take a few seconds to load. It helps you discover the correct parts for upgrading your PC, assuming you don't fall asleep while browsing it.

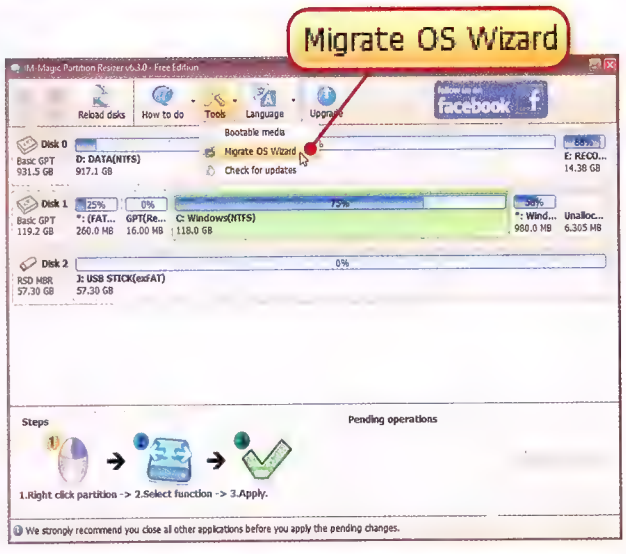
UNINSTALL BUILT-IN WINDOWS TOOLS

Some Windows tools can't be removed through the 'Apps & features' or 'Installed apps' section of the Settings app or the 'Uninstall a program' list in the Control Panel. Instead, you need to uninstall them via the Optional Features screen.

To access this, open the Settings app, select Apps then 'Apps & features' (in Windows 10 only) and click the 'Optional features' link. Here you'll see entries for apps we've covered in this feature, including Paint, Notepad and Windows Media Player, as well as obscure tools such as 'Windows Fax and Scan', Steps Recorder and WordPad.

Select an unwanted item and click the Uninstall button to remove it. If you later change your mind, click 'Add a feature', tick the box next to the removed tool and click Install.

IM-Magic Partition Resizer lets you migrate your current operating sytem to a different drive.



WHAT TO USE INSTEAD

CPU-Z

www.cpuid.com/softwares/cpu-z.html

CPU-Z scans your PC and installed hardware to generate a detailed report about everything from your processor type to the speed of your internal clock. You can explore this data more easily than in System Information by clicking tabs such as CPU, Mainboard and Graphics, and save the report as a text file. It also lets you 'validate' your system's specifications to compare them with other users.

If CPU-Z seems too complicated, try O&O DeskInfo.

16 Disk Management

The Disk Management tool in Windows, which you access by right-clicking the Start button, allows you to create, format and manage drive partitions without needing to install dedicated partitioning software. But if you've ever tried using this basic, slow and far-from-intuitive tool, you'll understand why so many third-party programs are available.

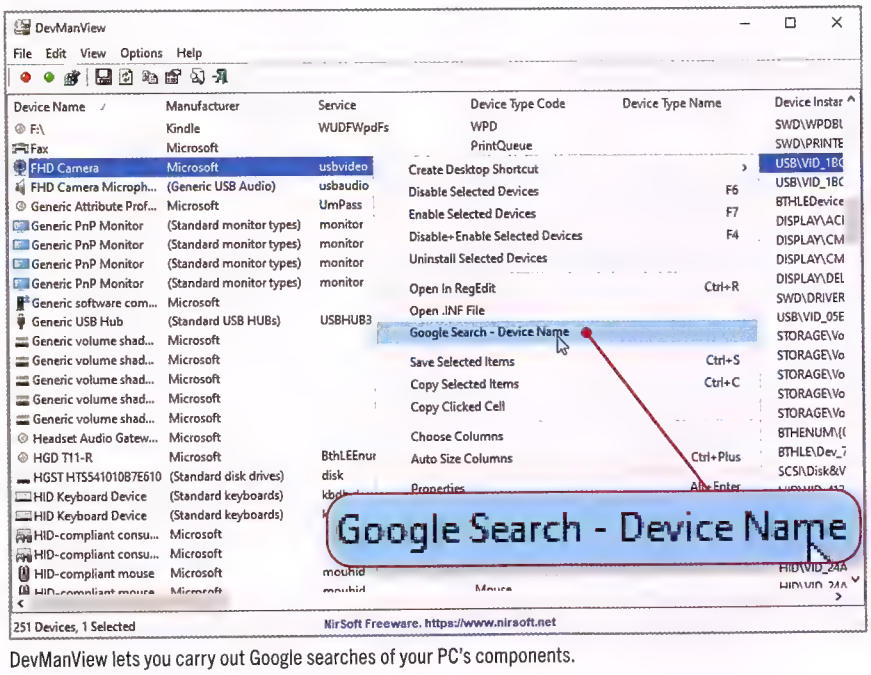
WHAT TO USE INSTEAD

IM-Magic Partition Resizer

www.resize-c.com

Putting a friendlier face on partitioning, IM-Magic Partition Resizer provides step-by-step instructions for tasks such as resizing, formatting and copying partitions, changing drive letters, converting NTFS to FAT32, and more.

Like other free partitioning tools, some features are limited to its paid-for version, but it doesn't nag you to upgrade – though there is an annoying 'follow us on Facebook' icon. It also lets you migrate your operating system to a different, empty drive (see screenshot above). ■



DevManView lets you carry out Google searches of your PC's components.

System News

Hot chips are nice, exploding chips – not so much. Mark Williams covers AMD's embarrassing oversight.

Mark Williams
Mark is an IT professional with a strong interest in voiding warranties.

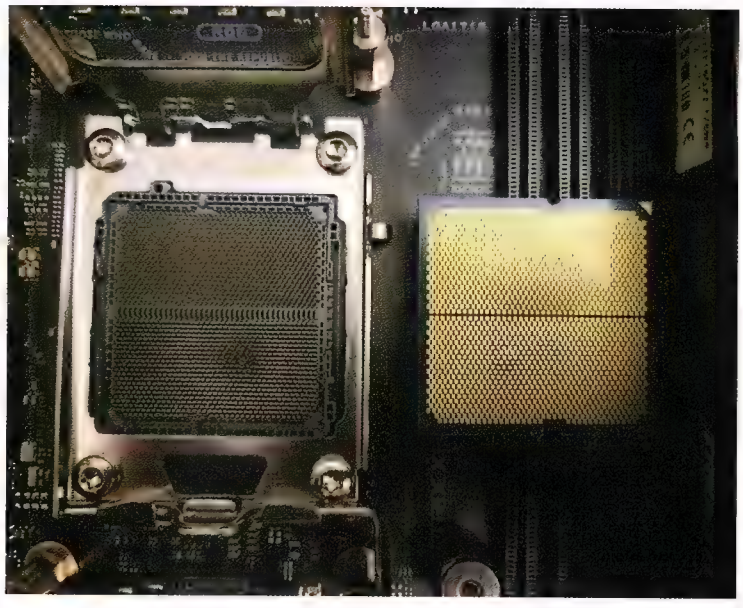
In late April several owners of AMD Ryzen 7000X3D CPUs began posting online about their now-dead CPUs. Strikingly, they were shown along with burned and bulging CPU substrates and damaged motherboard sockets.

As users banded together to try and find commonality between the dead CPUs, it soon emerged that all had EXPO memory timings enabled.

Enabling EXPO memory timings by itself shouldn't cause a CPU to burn out, EXPO merely contains various memory timings to run the DDR5 kit optimally and a voltage to run the memory kit at. Nothing out of the ordinary.

After some analysis by the tech community while they waited on AMD's investigation it came to light that motherboards made by Asus in particular were largely to blame for killing 7000X3D CPUs, though Asus wasn't alone, with an instance of a Gigabyte board also killing a processor.

It turns out that on some Asus motherboards, enabling EXPO memory profiles also caused the motherboard to set 1.35 SOC voltage, which is important as AMD explicitly say that X3D chips due to their voltage sensitive V-caches are not to be run at higher than 1.30v SOC. On further testing 1.4v was seen on Asus motherboards when put under heavy loads, causing the CPUs to slow cook themselves. The CPUs never ran above typical temperatures but the higher than-specced voltage caused the X3D silicon to break down leading to a short circuit, killing the CPU.



© Speedrookie/Reddit

"On some Asus motherboards, enabling EXPO memory profiles also caused the motherboard to set 1.35 SOC voltage, which is important as AMD explicitly say that X3D chips due to their voltage sensitive V-caches are not to be run at higher than 1.30v SOC."

This is where another failure was noticed, after shorting, when trying to boot the system again it was possible for Asus motherboards, while still in a double zero error code state, to push 36A of current into the CPU in an attempt to get it to boot. That's over 400W! This is what caused the subsequent CPU substrate bulging, burning, and socket damage. 7000X3D chips are only rated for 120W so this was an obvious failure of Asus's over-current protection mechanisms to recognise what was happening and shut the system off.

Within a couple of days AMD released a new AGESA revision that locked in 1.3v as the maximum possible SOC voltage for 7000X3D CPUs. All motherboard vendors have since released new BIOSes and removed the old bad ones.

This should stop the problem from ever happening again but it's obvious that Asus has some extra work to do on the OCP front to further protect against such runaway scenarios.

If you own an AMD 7000 series X3D CPU, it's highly recommended that you immediately update your BIOS to ensure the longevity and safety of your processor. ■

SHOP TALK

How popular has the Ryzen 7800X3D been? Have any customers been affected by the burnout issue?

Andre, JW Computers:
"Since AMD went with an entirely new chipset, the adoption rate has been relatively low due to the cost of the new upgrade. Sales were trickling but should start to pick up with more budget-friendly boards revealed/released.

Fortunately, we haven't received any returns or complaints from our end users. I believe the reason for this is our QA methods. Most of our users may have been using it stock and as such, it has saved them from RMA headaches and any downtime.

Luckily, as far as I know, even the customers that purchased individual components have not come back to us with this problem which also tells us that the cases would have been limited which is a good thing!"

Market Watch

A sampling of PC systems available this month.

SCORPTEC PHOENIX RX 7900 XT

$2,299 | tinyurl.com/APC521SCO

At the same price as the Aftershock system, this rig offers around 25 percent more gaming performance thanks to the RX 7900 XT. It also has double the SSD capacity at 2TB, it's a little slower, but games won't notice that very much.

The CPU, while good, isn't ideal if you're after high refresh rate gaming, as long as you keep quality settings high to load the GPU it is more than up to the task.
16GB of RAM is ok at this price though the 650W PSU is the bare minimum for the GPU inside.
A solid system for those that like playing with all the quality settings turned up.

CPU: AMD Ryzen 5 5600; **Cooler:** OEM; **Motherboard:** Asus Prime B550M-A WiFi; **Graphics:** Biostar Radeon RX 7900 XT 20GB; **Memory:** 16GB Kingston Fury Beast RGB 3200MHz DDR4; **Storage:** 2TB Kingston NV2 M.2 SSD; **Power Supply:** SilverStone Decathlon 650W; **Case:** Thermaltake Level 20 MT ARGB.

AFTERSHOCK PC FLOW DUAL: LVL 7R

$2,300 | tinyurl.com/APC521AFT

Matching the Scorptec system for price, this has a tougher time justifying itself with a slower GPU and half the SSD capacity. It sports a more powerful power supply but with such a power efficient graphics card the system won't use more than 500W.

The case is more premium and the aftermarket air cooler is nice too, though on a 65W CPU it's a little overkill when AMD's heatsink that's included with the CPU is more than enough. The 16GB of RAM however runs at the CPU's optimal speed of 3600MHz so in CPU bound scenarios this PC will have a slight advantage. A good system but perhaps a little overpriced.

CPU: AMD Ryzen 5 5600; **Cooler:** Aftershock M42 Frost Air; **Motherboard:** Gigabyte B550M DS3H; **Graphics:** Gigabyte RTX 4070 Windforce OC 12GB ; **Memory:** 16GB Corsair Vengeance Pro SL RGB DDR4 3600MHz; **Storage:** 1TB MSI Spatium M461 M.2. NVMe SSD; **Power Supply:** Inwin 750W; **Case:** Lian Li Lancool 205 Mesh C.

TI COMPUTERS DREAM 13700K

$3,695 | tinyurl.com/APC521TI

Coming in $200 more than the JW system, this PC has more included value than that one. Whilst the i7-13700KF CPU can stand toe to toe with the 7700X in games, it easily outperforms it in productivity tasks. The GPU is the major differentiator for this system, with the RTX 4070 Ti offering over 35 percent more performance. The motherboard also has the top-end Z790 chipset compared to a midrange chipset in the JW system. These three factors are well worth the extra $200 and offer more value overall even though the rest of the system including the 32GB of RAM, 1TB SSD and 850W PSU are all otherwise similar.

CPU: Intel i7 13700KF; **Cooler:** Asus TUF Gaming LC 240 ARGB AIO; **Motherboard:** Asus Prime Z790-Plus WIFI; **Graphics:** Geforce RTX4070 TI 12GB; **Memory:** 32G Kingston Hyper X DDR5 5200MHz; **Storage:** 1TB NVMe M.2 PCIe SSD; **Power Supply:** MSI 850W; **Case:** MSI Velox 100P Airflow.

JW COMPUTERS GMR STARKILLER 6750 XT

$3,499 | tinyurl.com/APC521JW

With the new *Star Wars Jedi: Survivor* game out, you might like to join the action with this Star Wars-themed system. Featuring a 1TB SSD with a lit lightsabre effigy. An Imperial sticker on the glass side panel and an included life-sized toy lightsabre. *Jedi: Survivor*, like many recent games, is very CPU heavy so it's fitting that the very capable Ryzen 7700X powers this system. The RX 6750XT GPU is a weak pairing but at 1080p will run the game above 75fps and at 1440p at around 50fps. 32GB of RAM is great as is the 850W PSU. A great themed build but the GPU will need upgrading sooner than later.

CPU: AMD Ryzen 7 7700X; **Cooler:** Cooler Master MasterLiquid ML240 Illusion ARGB AIO; **Motherboard:** MSI B650M-A WIFI; **Graphics:** Asus Dual Radeon RX 6750 XT 12GB; **Memory:** 32GB Corsair Vengeance RGB DDR5-5600; **Storage:** Seagate Firecuda 1TB M.2 SSD Lightsaber Special Edition; **Power Supply:** Thermaltake 850W; **Case:** Thermaltake AH T200 TG mATX.

PC BUILDER

Blueprints

Value- and performance-driven hypothetical builds

BUDGET

A perfect balance between price and performance.

In the last issue, we made quite a few changes on our Intel Budget Build. The biggest of them all was the GPU – no shock there! We swayed across from team Nvidia and hopped onto the new Intel GPU train with the A750. For 1080p gaming, we were more than satisfied with our results. Additionally, you can pick these up for $380. That's not a bad little package, is it?

So we kept this GPU in place, along with our newly added Intel Core i3-13100F for this issue. As for the rest of the Intel budget machine components, nothing changed other than our motherboard, the Asrock B660M-HDV Micro ATX. The Pro RS B660M Micro ATX board from Asrock is a better choice than last month's board, with two more DIMM slots for a larger maximum memory capacity.

As for our AMD machine, we swapped out the MSI MECH 2X OC Radeon RX 6500 XT, as this saw a price increase. We found the Asrock Phantom Gaming D OC 6500XTs for $229. Thankfully, we didn't need to change our AMD Ryzen 5 5600 that we added last time.

Nothing else changed, so we kept everything else the same as last month. This brought our overall price for the AMD budget machine to $1,122 (previously $1,132). Saving a tiny little bit of money, while not massive, is a move in the right direction. Thankfully things seem to be calming down after the pandemic pandemonium, which is what we like to see.

"We swayed across from team Nvidia and hopped onto the new Intel GPU train with the A750. For 1080p gaming, we were more than satisfied with our results."

AMD INGREDIENTS

Part		Price
Case	Corsair 4000D Airflow	$169
PSU	Thermaltake Litepower Gen2 450W	$59
Mobo	MSI B550M PRO-VDH WIFI Micro ATX AM4 Motherboard	$179
CPU	AMD Ryzen 5 5600	$209
GPU	Asrock Phantom Gaming D OC Radeon RX 6500 XT 4GB NEW	$229
RAM	16GB (2x 8GB) PNY XLR8 Gaming EPIC-X RGB DDR4 @ 3200MHz	$89
SSD	500GB PNY CS2140 PCIe 4.0 M.2 SSD	$59
HDD	2TB Seagate Barracuda Compute 7200	$69
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60
Total		$1,122

INTEL INGREDIENTS

Part		Price
Case	Corsair 4000D Airflow	$169
PSU	Thermaltake Litepower Gen2 450W	$59
Mobo	Asrock B660M Pro RS Micro ATX LGA1700 NEW	$219
CPU	Intel Core i3-13100F	$179
GPU	Intel Limited Edition Arc A750 8GB	$379
RAM	16GB (2x 8GB) PNY XLR8 Gaming EPIC-X RGB DDR4 @ 3200MHz	$89
SSD	500GB PNY CS2140 PCIe 4.0 M.2 SSD	$59
HDD	2TB Seagate Barracuda Compute 7200	$69
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60
Total		$1,282

"We're also paying more attention to the prices of our builds as of late – although the overall cost of these machines isn't as vital as it is for the budget systems, we're still making a conscious effort to make a great bang for your buck PC."

MID-RANGE

A game-ready machine that can also handle demanding work.

Moving on from our Budget Builds, we take a step up in performance thanks to an extended pot of virtual dollars with our Mid-range machines. With these PCs, we're sneaking into the QHD territory of gaming, which for us, is the happy medium. We're also paying more attention to the prices of our builds as of late – although the overall cost of these machines isn't as vital as it is for the budget systems, we're still making a conscious effort to make a great bang for your buck PC.

From the Ryzen 5 5600 budget AMD processor, we kick things up a notch up to the Ryzen 5 7600. This six-core processor with a max boost clock of 5.1 GHz is still being paired along with a Radeon 6750XT GPU, specifically the Gigabyte Gaming OC model.

We decided to give our motherboard not only an upgrade in form factor and memory capacity, but also a better chipset. We've ditched the B650M for a B650E with the Asrock B650E PG Riptide WIFI board. At $289, it's a future-proofed motherboard, and a big upgrade over the previous Asrock B650M PG Riptide Wi-Fi Micro. Aside from the motherboard change, we left things as they were, with a savings overall of $102 compared to last issue.

Over on the Intel mid-range machine, we ended up keeping the same lineup after recently adding a few new arrivals to the mix, including the CPU and GPU last issue. Across the board, we were happy to see yet more price reductions, including savings on our CPU, GPU, RAM, CPU cooler, and SSD. This saved us a total of $90, which could easily be spent on doubling the secondary hard drive storage if you need it.

AMD INGREDIENTS

Part		Price
Case	Nzxt H7 Flow	$259
PSU	750W EVGA 750 BP 80+ Bronze	$109
Mobo	Asrock B650M PG Riptide Wi-Fi Micro ATX AM5 NEW	$289
CPU	AMD Ryzen 5 7600	$349
Cooler	Cooler Master Masterliquid ML240L RGB V2	$109
GPU	Gigabyte Radeon RX 6750 XT Gaming OC 12GB	$599
RAM	32GB (2x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	$220
SSD	1TB Crucial P5 Plus NVME M.2 PCIe 4.0	$129
HDD	2TB Seagate Barracuda Compute 7200	$69
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60
Total		$2,192

INTEL INGREDIENTS

Part		Price
Case	Nzxt H7 Flow	$259
PSU	750W EVGA 750 BP 80+ Bronze	$109
Mobo	Gigabyte Z790 UD AX ATX LGA 1700	$379
CPU	Intel Core i5-12600KF	$389
Cooler	Cooler Master Masterliquid ML240L RGB V2	$109
GPU	Gigabyte GeForce RTX 3060 Ti Eagle OC 8GB	$599
RAM	32GB (2x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	$220
SSD	1TB Corsair MP600 PRO NH M.2 PCIe 4.0	$159
HDD	2TB Seagate Barracuda Compute 7200	$69
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60
Total		$2,352

"These PCs are designed to give you the best "money-no-object" experience – if we can save some money then we will, but you get the idea."

TURBO

The maximum PC.

Amping everything up to the max are our Turbo builds. As the name implies, they are mighty fast, and if they go wrong, they will take you on a first-class trip to financial ruin. Even so, we live for these machines. These PCs are designed to give you the best "money-no-object" experience – if we can save some money then we will, but you get the idea.

In our main build, we got our hands on the range-topping AMD Ryzen 9 7950X3D processor. This was very impressive, although against the Intel Core i9-13900K, it was slightly behind on our benchmarking results. It's one heck of a powerhouse, which is why we are introducing it to the AMD Turbo. To cool this, we've also included the Nzxt Kraken X73 360MM AIO from that build. It kept our CPU running smoothly, and the infinity display is a nice aesthetic touch.

Giving us the most grunt is once again the Asrock Phantom Gaming OC Radeon RX 7900 XTX. It's a 24GB pre-overclocked graphics card, and (at the time of writing) still the top-performing model in AMD's GPU lineup. At under $1,700, it's cheaper than Nvidia's top card, the RTX 4090. Just like the GPU, we didn't alter the rest of the build.

We haven't changed the Intel hot seat – the faithful Core i9-13900K remains. Next to that is our 64GB Corsair Vengeance DDR5 RAM that runs at 5200MHz. This is also in the AMD Turbo build. We've stuck with the Western Digital 1TB SN850X as our primary drive, and 6 TB of Western Digital Blue as our secondary storage. The GPU also remained, as it's one of the least expensive RTX 4090s at under $2,800.

Our only change was our Nzxt C1000 PSU to Corsair's RM1000x 80+ Gold due to needing an extra PCIe port. Our RTX 4090 needed four individual PCIe cables, and we could only use three, which slightly restricted the GPU's power! Woes aside, the Intel Turbo build was cheaper than previously, with a saving of $105, bringing it down to $5,633.

AMD INGREDIENTS

Part		Price
Case	Phanteks Enthoo Pro 2 Tempered Glass	$299
PSU	1,000W Nzxt C1000 80+ Gold	$229
Mobo	Asrock X670E PG Lightning ATX AM5	$449
CPU	AMD Ryzen 9 7950X3D NEW	$1,139
Cooler	Nzxt Kraken X73 RGB 360mm NEW	$319
GPU	Asrock Phantom Gaming OC Radeon RX 7900 XTX 24GB	$1,699
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	$369
SSD	1TB WD Black SN850X M.2 PCIe 4.0	$155
HDD	6TB WD Blue 5400 HDD	$189
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60
Total		$4,907

INTEL INGREDIENTS

Part		Price
Case	Phanteks Enthoo Pro 2 Tempered Glass	$299
PSU	1,000W Corsair RM1000x 80+ Gold NEW	$229
Mobo	Gigabyte Z790 UD AC ATX LGA 1700	$369
CPU	Intel Core i9-13900K	$845
Cooler	Nzxt Kraken X73 RGB 360mm NEW	$319
GPU	Zotac GeForce RTX 4090 Gaming Trinity OC 24GB	$2,799
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	$369
SSD	1TB WD Black SN850X M.2 PCIe 4.0	$155
HDD	6TB WD Blue 5400 HDD	$189
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60
Total		$5,633

PC GAMER

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QUICK TIPS

The problem solvers

The APC team field problems across the spectrum of devices and software. Learn a new trick or fix you can use.

M.2 adapter for storage

I'm considering building a small-factor NAS-like server based on an Asrock J4125-ITX board in a four-bay tower. I need to keep the PCI-e slot free for a TV tuner card, and want to use all four onboard SATA ports for storage, so I was wondering if I can run the OS from a NVMe drive plugged into the M.2 (Key E) slot?

Martin Bilton

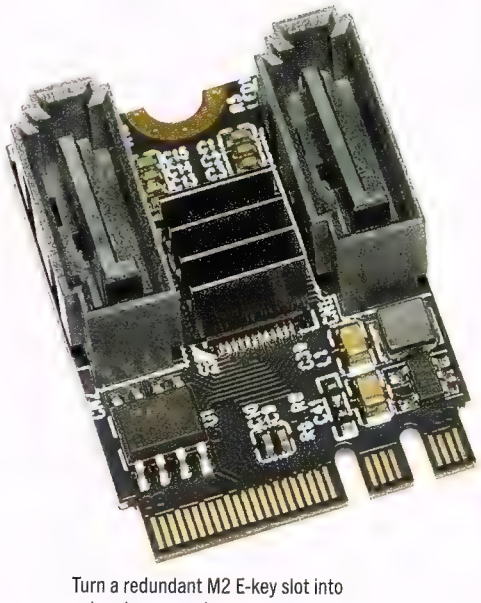
APC responds: The short answer is yes. There are numerous adapters that can convert the Key E slot into one for plugging in both SATA and NVMe drives. If all you need is extra storage, search eBay for 'M.2 key A+E male' to add two SATA ports via a $10-15 adapter. TAPC recently fitted one with a JMB58x controller to replace a PCIe SATA adapter, and it works perfectly.

You specifically talk about booting from an NVMe drive, and APC can also confirm that this is possible, having seen one working. Despite the fact that the Key E slot runs at PCIe 2.0, meaning you won't get anywhere near NVMe's theoretical top speed of around 3Gbps, you should be able to eke out better performance from it than with a standard SATA SSD drive.

Given that NVMe adapters cost around the same as the SATA adapter, your only consideration at this point is whether there's enough space in the case to accommodate the NVMe drive itself, which has to be mounted vertically.

If that proves to be a dealbreaker, but you're determined to go with NVMe over SATA, APC has an alternative approach. It involves allocating the motherboard's solitary PCIe 2.0 x1 slot to your boot drive and replacing the TV tuner. For under $65, you can purchase both the required PCIe x1 NVMe adapter (around $12-15 online) and the low-powered 1TB Patriot P300 M.2.

That leaves you with the task of sourcing a replacement TV tuner – a USB tuner costs as little as $30. If you're feeling flush, why not investigate a network-based option like HD Homerun's Flex (local TV) or Prime (cable TV) tuners? And remember to make sure the tuner is compatible with your operating system (in the case of the HD Homerun boxes, you'll need to source a media server like Jellyfin or Plex that supports them).



Turn a redundant M2 E-key slot into extra storage ports.

Subscription-free surveillance

I'm looking for a home surveillance system that is 'self-contained'. I could be wrong or overlooking something, but every home surveillance product that I see requires an internet connection and a fee for recording and holding the video off-site for a specified time. Is there a way to set up a home surveillance system that is self-contained within a person's home? If so, maybe an article can be written to address all the hardware and software required to make it work. How to set it up and integrate with the desktop computer and possibly a mobile device would be of interest too.

There may be many others like me, who refuse to pay a monthly fee for any computer service except for my internet carrier. Whatever it is, I want to purchase it, maintain it, and keep it to myself. I do not want to rent it, lease it, or have a third party involved. Perhaps it's paranoia or preference for independence, but I strive to have full control over my personal space.

Mike Burkhead

APC responds: The good news is that yes, you can keep your recordings to yourself. Some cheap eBay webcams, based on the V380 Pro app, come with SD card slots to let you keep recordings without a subscription, but you still need to register the webcam with the app to access recordings and monitor your camera remotely, and it aggressively promotes its cloud-based subscription whenever it can.

An option for those with a Synology and QNAP NAS is their built-in surveillance software – Surveillance Station (**www.synology.com/en-us/surveillance/overview**) and QVR (**www.qnap.com/en-us/utilities/surveillance**) respectivel – that work with a range of local and network (IP) cameras and let you store your recordings on your NAS rather than the cloud. They're free for use with up to two cameras, and video feeds are AES-256 encrypted when streamed, but you'll have to pay if your setup requires more cameras.

One open-source option does exist, and that's based around the Motion and MotionPlus (**https://motion-project.github.io/**) protocols. It is a little fiddly to set up, but you won't have to pay for streaming or recording from your surveillance cameras.

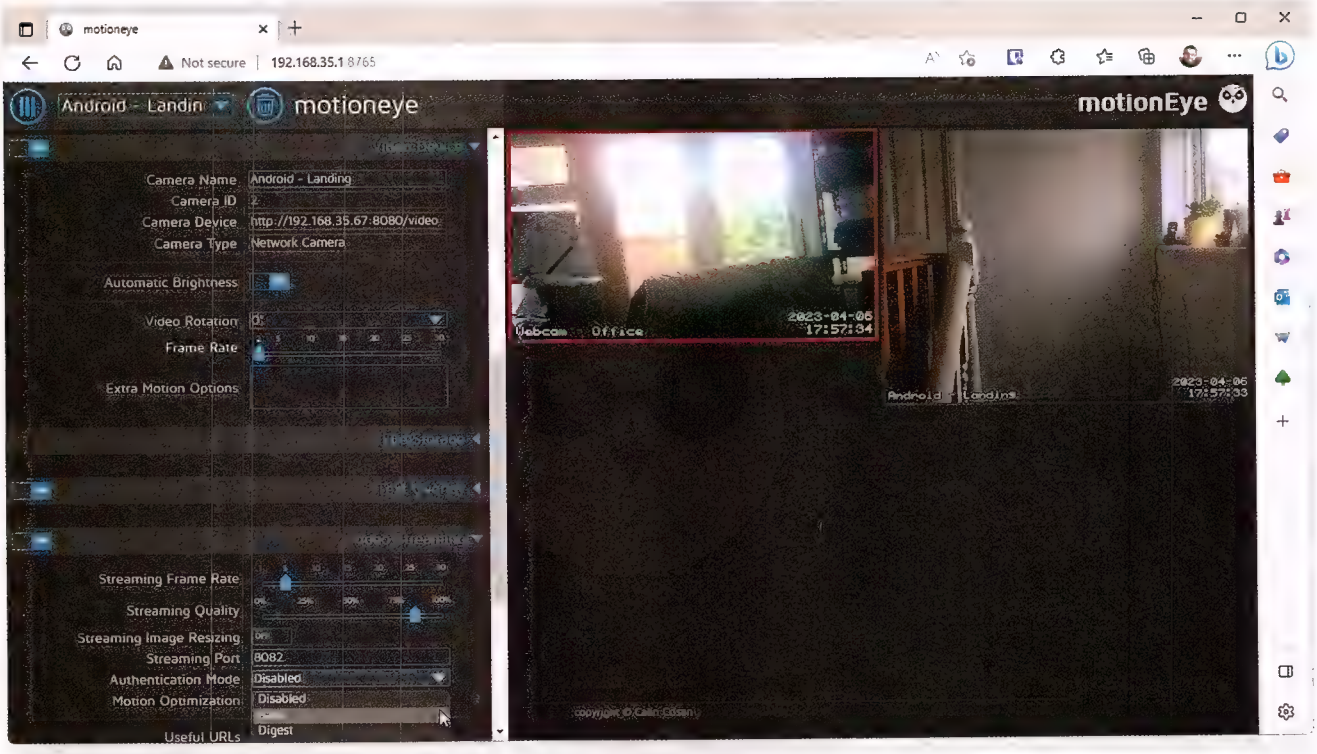
The most promising is MotionEye (**https://github.com/motioneye-project/motioneye**), which can be installed through Docker or Linux. APC has tested the former with a USB webcam attached to his Ubuntu-powered server, as well as an old Android phone over Wi-Fi, and it should work with other network/IP cameras, the Raspberry Pi camera, and selected composite video cards.

Colour display question

If the three primary colours are red, blue, and yellow (with yellow and blue making green), then why do displays use red, blue, and green to get their colours?

Chris Williams

APC responds: The notion of red, yellow, and blue (RYB) as the primary colours goes back to the 17th century, based on artists' experience mixing pigments together. On the other hand, the science of light posits that red, green, and blue (RGB) are the actual primary colours, with yellow a mixture of red and green light. The popularity of the RYB model sees many digital artists continue to use a



motionEye is an open-source solution for home surveillance.

RYB wheel. It also explains the use of CMY (cyan, magenta, and yellow) and CMYK (the 'k' being an additional black ink) cartridges in printers, which follow the RYB model, and are used in magazine printing due to their more accurate colour reproduction.

Digital displays use RGB because they can reproduce a wide range of colours from mixing the three together, meaning LCD pixels can be made up of three subpixel elements, one for each colour.

Cockpit not Docker-friendly

I am having an issue with Docker containers not working in the Cockpit Dashboard on my Ubuntu Server NAS. When I select 'Docker containers' from the left-hand menu, it displays 'Oooops' in red. Then it reports that 'Cockpit had an unexpected internal error'. Have you seen this issue when trying to use Cockpit with Docker containers? I would appreciate any suggestions, as I have been unable to find a resolution.
Frank Gunseor

APC responds: It sounds like you may have built your Ubuntu Server NAS following our older guide back in 2021, Frank. We'd installed an outdated version of cockpit using Ubuntu 20.04's default repo that – at time of writing – supported cockpit's Docker module. The module had been retired, as cockpit's developers chose to support Red Hat's Docker alternative, Podman (**https://podman.io/**).

When cockpit switched support, Podman was in the early stages of development, and not ready for primetime. Its Docker module worked, but as time went on, it became less reliable. We've updated Ubuntu to 22.04 LTS and installed cockpit through the Jammy Jellyfish 'backports' repository, which enables cockpit to stay up to date instead of being 'stuck' at the version installed when Ubuntu 22.04 LTS came out.

This means that Docker containers can no longer accessed through cockpit – you can switch to Podman if you like, which is compatible with regular Docker containers, or try a different web-based UI. We recommend Portainer (**www.portainer.io**), which offers a more powerful frontend than cockpit's original Docker module, and requires access through a separate tab.

Use Docker in Windows

I'm intrigued by your many tutorials that use Docker-based containers to run services on your computer. I need to run WSL 2 to access Docker on my Windows PC, but am having trouble getting it running. Can you help me please?
Jeffrey Ryder

APC responds: WSL 2 is basically the Windows Subsystem for Linux, which allows you to run a wide variety of Linux distributions in Windows. However, it requires hardware virtualisation. To check this is enabled, right-click the taskbar, choose Task Manager, then Performance, and check the Virtualisation status under CPU.

If it's set to Disabled, reboot into your UEFI/BIOS and look for the settings you need under CPU. These can be tricky to find, as they can be called a number of things: VT-x, AMD-V, SVM, or Vanderpool are options. In addition, enable an Intel VT-d or AMD IOMMU option if it's present. Check your motherboard manual or ask on your motherboard support forum to find the required setting.

Once virtualisation is enabled, the quickest way to install WSL 2 (based on Ubuntu 22.04 LTS) is to right-click the Start button and choose Terminal (Admin), then type the following command and hit Enter:

```
wsl --install
```

Once installed, reboot your PC and a Terminal window will open asking you to set up your Linux username and password. Once done, WSL 2 will be in place. You can install Docker Desktop for Windows (see **https://docs.Docker.com/desktop/install/windows-install/**) if you wish, or install Docker into Linux from the Terminal by following the instructions at **https://docs.Docker.com/engine/install/ubuntu**. Before starting the Docker service, enter the following command:

```
sudo update-alternatives --config iptables
```

Select option 1 (iptables-legacy), hit Enter, then start the Docker service. You should now be able to run Docker containers from the Terminal in Windows. ■

WINDOWS

Make Windows better

Expert tips for every version.

WINDOWS 11

Tap bigger taskbar icons in tablet mode

Released in March, the 'Moment 2' update adds a new taskbar design to make it easier to use when you've got Windows 11 in tablet mode. On the left of the screenshot above is the 'expanded' mode, which shows bigger taskbar icons 1. Windows 11 will automatically switch to this taskbar when you remove or fold back a keyboard on a laptop-tablet '2-in-1' machine.

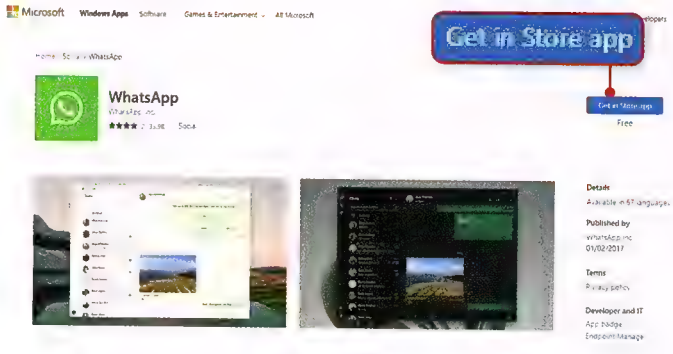
A second new 'collapsed' mode removes the taskbar icons, leaving only the information on the System Tray at the bottom right, such as the time and battery status 2. As well as freeing up more screen space, it means you won't accidentally trigger the taskbar with your fingers while holding your device at the bottom. You can switch between expanded and collapsed modes by swiping up from the bottom of the screen.

These modes are activated by default on laptop-tablet devices running Windows 11. To disable them, open Settings (press Windows key-I), then click Personalisation, Taskbar, 'Taskbar behaviours' and turn off the slider next to 'Optimize taskbar for touch interactions when this device is used as a tablet'. Visit Microsoft's site to see all the touchscreen commands you can perform when using Windows 11 in tablet mode: **www.snipca.com/45633**.

WINDOWS 10 & 11

Make WhatsApp calls with more people

WhatsApp has increased the number of people you can have chats with in the Windows version. You can now make video calls with up to eight people, and audio calls with up to 32. To do this, you'll need to install the new version of WhatsApp from the Microsoft Store – visit **www.snipca.com/45637** and click 'Get in Store app' (see screenshot right).



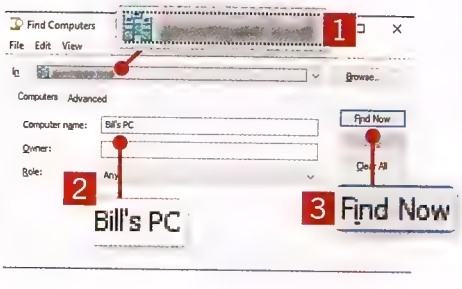
If you have a previous version installed, search for and open Microsoft Store in Windows, then click Library at the bottom left. You'll then see all your Store apps that need updating. Clicking 'Get updates' will do this simultaneously.

WhatsApp claims the new app loads faster, and that it will increase the people limit "over time" (see **www.snipca.com/45638**).

WINDOWS 10 & 11

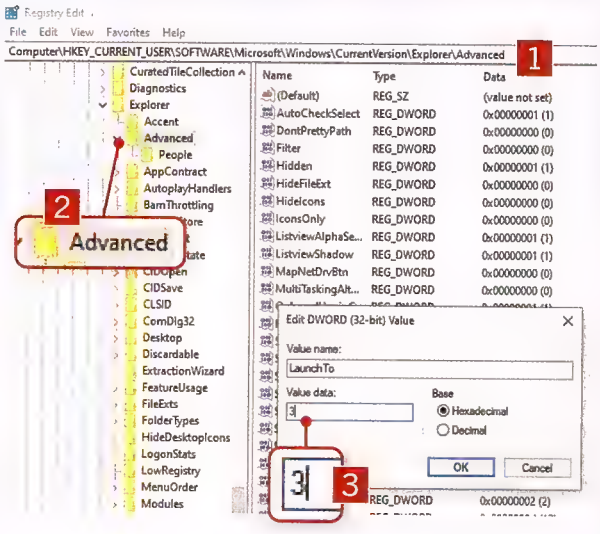
Search for computers on your network

If you often have to search for computers connected to your home network, memorise the keyboard shortcut Windows key-Ctrl-F. This will bring up the Find Computers box with the Computers tab selected. Change the network in the dropdown menu if you need to (1 in our screenshot below), then type the name of the computer you're looking for 2 and click Find Now 3. The results will appear in a panel at the bottom. ■



SET FILE EXPLORER TO OPEN IN THE DOWNLOADS FOLDER

With a registry tweak you can make File Explorer always open in your Downloads folder. First, press Windows key-R then type regedit and click OK. Now navigate to Computer\HKEY_CURRENT_USER\Software\Microsoft\Windows\CurrentVersion\Explorer\Advanced, or copy it from this Pastebin page (**www.snipca.com/45639**) and paste it into the toolbar at the top (1 in our screenshot). Next, right-click the Advanced folder 2, then select New, followed by 'Dword (32-bit) Value'. Type LaunchTo to name it. Now double-click this entry and type 3 in the 'Value data' box 3. Click OK to confirm the change. You don't need to restart your computer for it to take effect. To reverse the change, just right-click LaunchTo, select Delete then click Yes to confirm.



MICROSOFT OFFICE

Make Office better

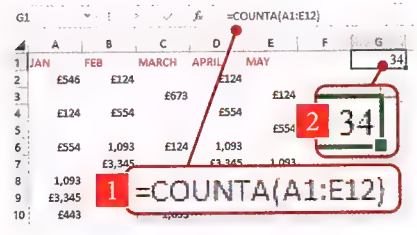
Top tips for the best office programs

MICROSOFT EXCEL

Count the number of cells containing data

The COUNTA function counts how many spreadsheet cells are not blank – which means those that contain any form of value or information. Cells that contain a zero are counted, as are those that show an error message.

In our example, we want to count how many non-blank cells there are between A1 and E12. We click in the cell we want the answer to appear in (G1), then type =COUNTA(A1:E12) (1 in our screenshot below). This produces the answer 34 2. The same function works in LibreOffice Calc and OnlyOffice.



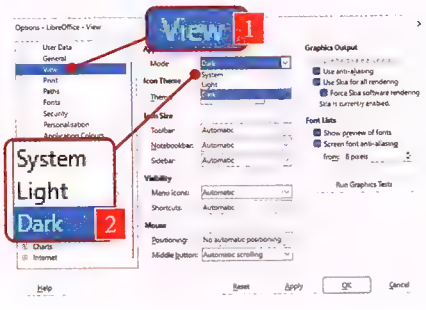
LIBREOFFICE

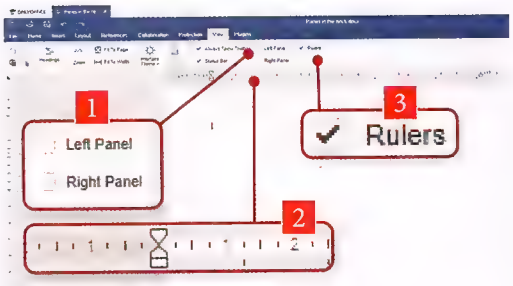
Switch on dark mode manually

Released in February, LibreOffice 7.5 was a major update that added several handy new tools, including a dark mode that automatically matched your system settings. So, if dark mode is switched on in Windows, LibreOffice would recognise this and turn dark mode on automatically.

One month later, following feedback from users, LibreOffice released 7.5.1 which added the option to turn dark mode on and off manually. To see this, click the Tools tab at the top, followed by Options at the bottom (or press Alt-F12). Now click the LibreOffice menu on the left, then View (1 in our screenshot below), and select System, Light or Dark in the Appearance dropdown menu 2. Finally, click OK.

At the time of writing the latest version of LibreOffice is 7.5.2 – download it from **www.libreoffice.org/download**.





ONLYOFFICE

Hide the left and right panels in documents

Version 7.3 of OnlyOffice added a new option to remove the left and right panels from a document page, making it appear less cluttered. The left panel shows four options (Search, Comments, Headings and 'Feedback & Support') and the ruler for aligning text and setting margins. The right-hand panel has options for line and paragraph spacing, as well as indents and adding a background colour.

If you don't need these, click the View tab at the top of a document, then untick the Left Panel and Right Panel boxes (1 in our screenshot above). This will leave the horizontal ruler running along the top 2 – you'll need to untick Rulers 3 to remove this.

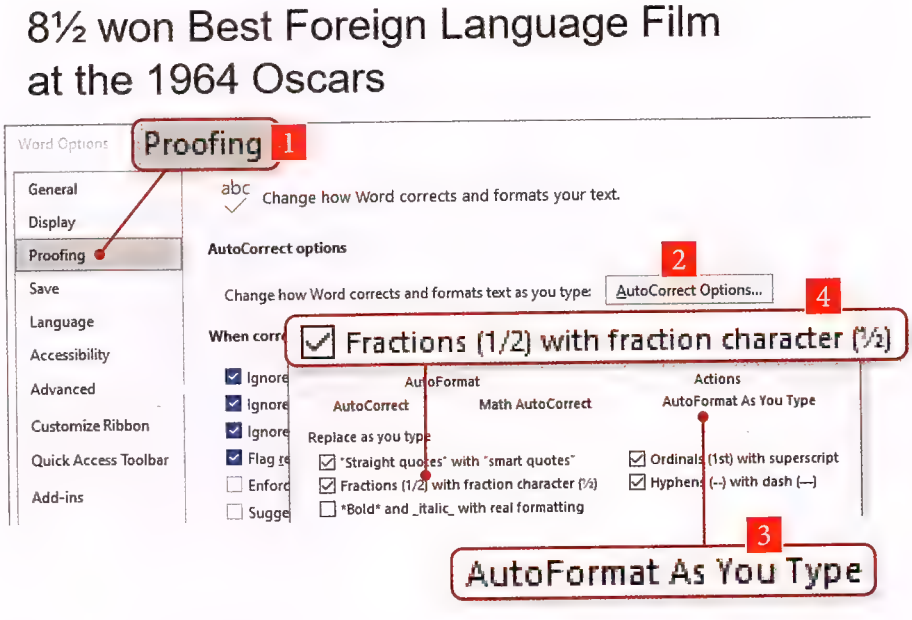
MICROSOFT WORD

Make Word show fractions as you type

There are several ways to show complicated fractions in Word documents, including by using the Symbols menu and the Character Map in Windows.

However, if all you ever need to type is ½, ¼ and ¾, you should set Word to do this automatically. Click 'File' at the top of a document, then select Options at the bottom. Next, click Proofing in the left-hand menu (1 in our screenshot) and select AutoCorrect Options on the right 2. Now click the AutoFormat As You Type tab 3 and tick 'Fractions (1/2) with fraction character (½)' 4, followed by OK. With this activated, typing 1/2 then pressing Space or Enter will automatically change to ½, 1/4 to ¼ and so on.

Note that if you want to type a whole number before the fraction, such as 8½, you'll need to add a space after it.



MAC OS

What's new in Affinity Photo 2

Put the app's tools through their paces to create eye-catching images.

IT WILL TAKE
15 minutes

YOU WILL LEARN
How to use masks, creatively displace text, and perform non-destructive Raw edits

YOU'LL NEED
Affinity Photo 2,

Affinity Photo 2 lets you process Raw format files, edit images in layers and push pixels around to change reality! If you're familiar with Adobe Photoshop then Affinity Photo 2 will be easy to adapt to and you don't need to pay a monthly subscription.

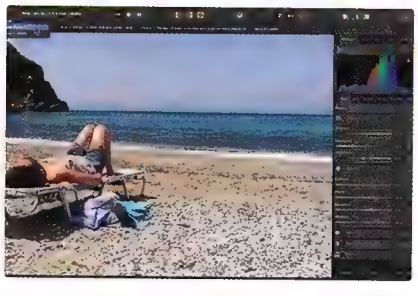
Affinity Photo 2 features a collection of new features, updated tools and interface tweaks that help this photo-editing app remain a viable alternative to Photoshop. One of the most useful new features is non-destructive Raw editing. This enables you to tweak the colours and tones of a Raw file even after it has become part of a layered document.

The new Compound Masks feature lets you add and subtract multiple layer masks to take even more control of what's revealed and what's hidden on a corresponding layer.

We'll walk you through some of the app's key new features here, so you can get started with this excellent photo editing app and get going with improving your digital art.

George Cairns

HOW TO MAKE NON-DESTRUCTIVE RAW EDITS

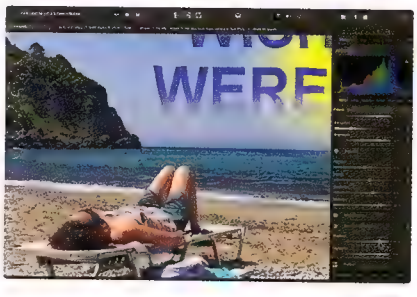


1 PROCESS RAW FILE

Choose File > Open. Browse to a Raw format file such as a .dng file captured by a Pro iPhone. This opens the image in the Develop Persona. After boosting Vibrance and Clarity set Output to Raw Layer (Embedded).

2 WORK WITH LAYERS

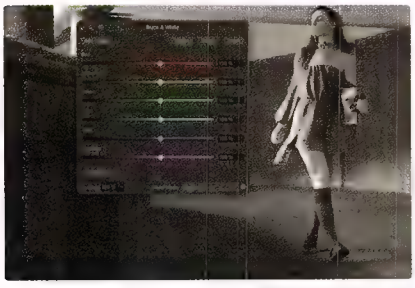
Click Develop. This takes the edited Raw file into the Photo Persona. Here you can edit the image using adjustment layers, filters, masks and text. If you need to re-edit the original Raw file double click on its layer.



3 BACK TO DEVELOP

We're now back in the Develop Persona, where we can use the Shadows Highlights panel to reveal more detail on the island without adding nasty noise. We can then click Develop and carry on editing our layered document.

HOW TO EXPLORE THE LIVE HUE RANGE MASK



1 MAKE IT MONO

Open a shot with a colourful subject. Go to Layer > New Adjustment Layer > Black & White. This desaturates the entire shot. You can then adjust the colour sliders to lighten or darken greyscale tones of specific colours.

2 ADD LIVE MASK

Go to Layers > New Live Mask Layer > Hue Range. The mask initially reveals all of the colours originally desaturated by the adjustment layer. Drag inside the ring to change the range of the B&W a djustment layer.

3 CLICK THE PICKER

To work more quickly, click the Picker button then click to sample the colours you want to reveal. Drag control points on the Hue ring to fine-tune which colours remain while desaturating the rest of the shot.

HOW TO USE THE LIVE DISPLACE FILTER

1 TYPE SOME TEXT

Use the Artistic Text tool to type a title on to a new layer. The Text tool creates vector-based text that we can edit any time, even after we creatively displace it with the filter (hence the term 'non-destructive').

2 DISPLACE THE TEXT

Go to Layer > New Live Filter Layer > Distort > Displace. The new Live Displace panel appears. Set Load Method to Red/ Green offset. Click Load Map from layers beneath. Increase the Strength slide to distort the text.

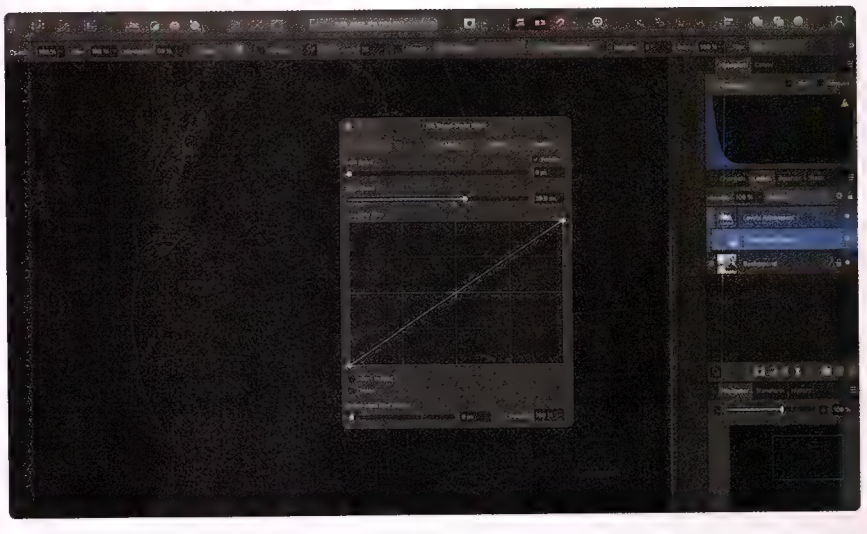
3 FINETUNE THE TEXT

You are now free to rotate and reposition the text to see how it becomes creatively displaced by the pixels on the layers below. You can edit the text's spelling and adjust the displacement strength at any time.

LIVE BAND-PASS MASK

Give key areas extra emphasis

A subtle way to emphasise key areas in a portrait (such as eyes) is to use the new Live Band-pass mask. Add a Levels adjustment layer. Drag the Black level slider to 80 percent to darken the shot. Go to Layer > New Live Mask Layer > Band-pass. Tick Mask Preview and zoom in to a greyscale version of the image. Drag the Low Band slider left to include finer edge details such as eyelashes. Drag the High Band slider right to add flatter tones. Turn off Mask Preview to see how the masked Levels adjustment layer emphasises details such as eyes and hair. ■



MOBILE DEVICES

Phone and tablet tips

Brilliant things to do on your device.

iOS

Improve the sound quality of phone calls

One of the best new features in iOS 16.4, which was released at the end of March, lets you improve the audio quality of phone calls you make on your iPhone. It's called Voice Isolation and uses machine learning to remove background noise and block microphone interference so your calls sound clearer than ever.

Previously, Voice Isolation was available for VoIP calls in apps such as FaceTime and Skype, but it now works for calls you make over your mobile network. However, the feature isn't enabled by default and can only be switched on during a call – once it's activated, it will remain so for future calls.

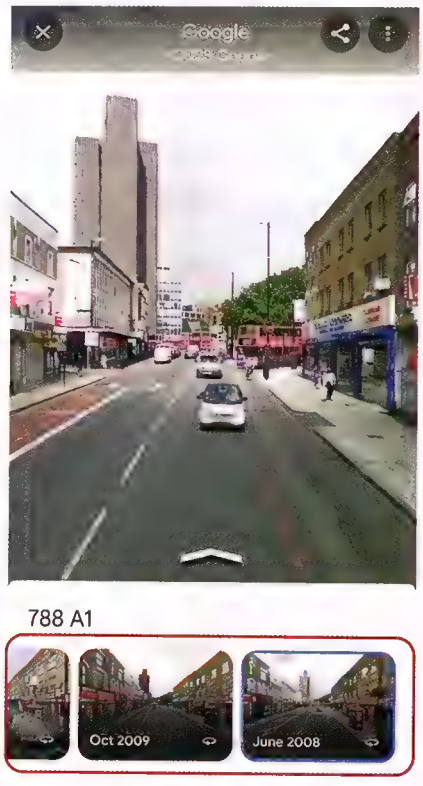
To turn on Voice Isolation, start a phone call and once the other person answers, swipe down from the top of your iPhone's screen to access the Control Centre. Tap the Mic Mode tile and select Voice Isolation (see screenshot below left) to enable the feature for the current call and all subsequent ones. You'll also notice an option called Wide Spectrum, which enhances noise around you without affecting your voice, but this isn't available for standard phone calls yet.

If you find that the microphone quality is now almost too pristine and makes your voice sound unnatural, tap the Mic Mode tile again and revert to the Standard option.

ANDROID & iOS

Travel back in time with Google Maps

Ever wondered how an area you're visiting, or are planning to visit, looked five, 10 or even 15 years ago? You can find out using a new feature in the Google Maps app, which uses the service's Street View imagery.



Search for a location, then tap it on the map and press the Street View photo that appears in the bottom-left corner (this has a white roundabout icon in its own bottom-left corner). When Street View opens, a panel at the bottom of

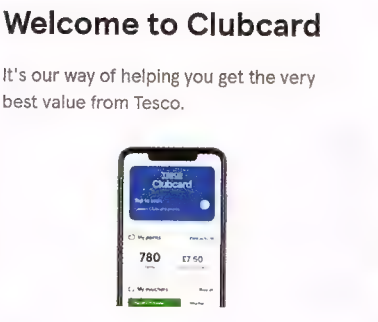
BEST NEW APPS

What you should install this month

HIPSTAMATIC

Free* | iOS www.snipca.com/45578

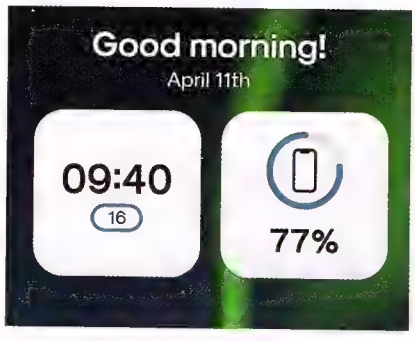
This popular camera app for applying retro-style filters to your photos has relaunched as a social network for avid photographers. Share your latest snaps with up to 99 followers, and vice versa, in a simple interface that's free of adverts, videos and 'influencers'. To unlock premium features, you need to pay $4.49 a month.



TESCO GROCERY & CLUBCARD

Free | Android www.snipca.com/45643
iOS www.snipca.com/45644

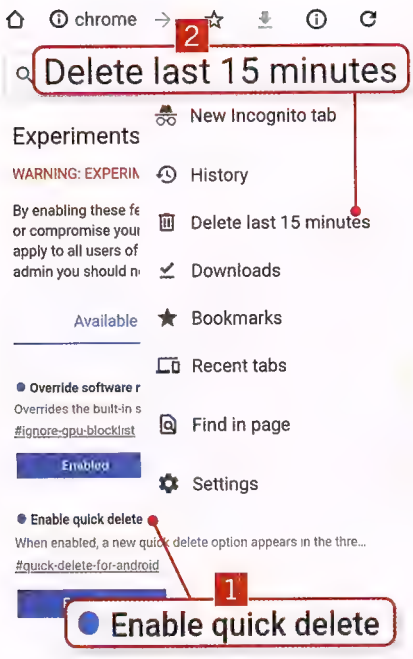
Following the closure of its Pay+ and Clubcard apps, Tesco has revamped its Grocery app to combine the features of all three. This means you can now collect and spend Clubcard points, in-store and online, and check stock at your local Tesco store – all in one place. Saved points and vouchers will be automatically transferred.



STARIO LAUNCHER

Free | Android www.snipca.com/45648

Declutter your phone's home screen using this minimalist new launcher, which replaces app shortcuts and widgets with a simple clock, battery indicator and search box. Swipe left to create notes to yourself, swipe right to add RSS feeds for your favourite sites and swipe up to browse and search your installed apps.



your screen will tell you when the current image was captured by Google's Street View cameras.

Tap 'See more dates' to explore imagery from earlier dates (see screenshot above), so you can see how the place has changed over time. Google began capturing Street View photos in Australia in June 2008, following its launch in the US a year earlier, which means you can potentially travel back nearly 15 years – though many areas weren't added until later.

Note that Google shut down its separate Street View app on 31 March, so its features have now been incorporated into the Google Maps app – any other Street View-branded apps you come across are unofficial and potentially risky.

ANDROID

Delete the last 15 minutes of your Chrome activity

Google has updated the Android version of its Chrome browser to let you delete the last 15 minutes of your browsing data. You can already clear the last hour, 24 hours, and seven days of activity, but the new option allows you to be more precise about the data you wipe – both from your phone or tablet and from Google's servers. The feature is currently an experiment in the Chrome app that you need to enable manually.

To do so, type chrome://flags into the browser's address bar, press Enter and search for the entry Enable quick delete (1 in our screenshot above). Tap the dropdown menu below it, select Enabled and relaunch Chrome.

When the browser reopens, tap the three-dot menu in the top-right corner and you'll see a new option to 'Delete last 15 minutes' 2. Select this and tap Delete to wipe the last 15 minutes of your browsing history, cookies and site data, as well as any cached images and files. We found the new option sometimes causes Chrome to crash, which is evidently why it's still an experiment.

The Google app for Android also offers this option. Tap your profile icon in the top-right corner of the app and choose 'Delete last 15 minutes'.

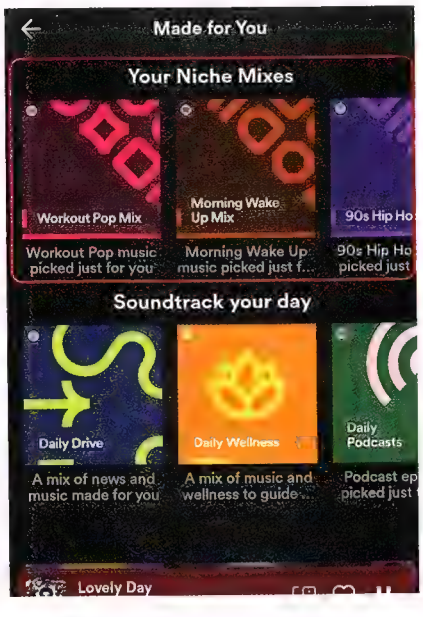
ANDROID & iOS

Listen to Niche Mixes on Spotify

Spotify has annoyed many users by adding auto-playing videos to the Home screen of its mobile app, which it's currently not possible to turn off. However, it's also added a more useful feature called Niche Mixes, which uses AI to generate personalised playlists based on specific themes. These are different from the existing playlists that group songs by genre, artist, decade or mood.

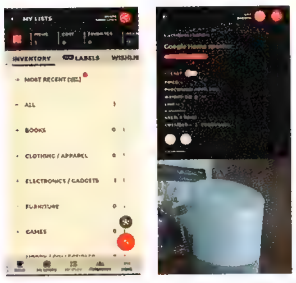
To access the feature, tap the Search tab in the Spotify app for Android (**www.snipca.com/45575**) or iOS (**www.snipca.com/45576**), and choose Made For You. Swipe down to the new Your Niche Mixes section (see screenshot right) and you'll see a selection of compiled playlists with names such as Morning Wake Up Mix, Walking Workout Mix and Driving Sing Along Mix. These combine songs from your Spotify library with relevant recommendations, so you can listen to familiar tracks and discover new ones.

To access further Niche Mixes, tap the Search tab and type a theme followed by the word mix to see what comes up – for example, baking mix, quiet late night mix or cold rainy day mix. You can 'Like' mixes to add them to your Spotify Library.



BEST APPS FOR...

Decluttering your home



BYEBYE

Free* | Android www.snipca.com/45649
iOS www.snipca.com/45650

Use this app to create an inventory of old clothes, gadgets, books and other items, including photos and (optionally) the purchase date and price. Add labels such as 'barely used', 'essential' and 'sentimental', and mark items as 'favourites' or 'regrets', to analyse your hoard and help you decide what to bin, sell or donate to charity.

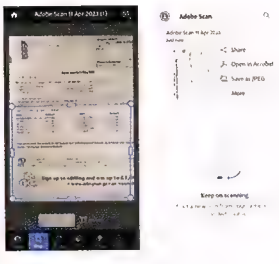
Best For: Creating an inventory

TODY

Free* | Android www.snipca.com/45651
iOS www.snipca.com/45652

Tody lets you create a cleaning schedule for your home – room by room, including tasks such as decluttering, dusting and sweeping the floor. You can specify how urgent each task is, assign tasks to other family members and even turn cleaning into a game. The iOS version is pricey, though.

Best For: Managing cleaning tasks



ADOBE SCAN

Free* | Android www.snipca.com/45653
iOS www.snipca.com/45654

Reduce paper clutter in your home without losing important information by scanning receipts, bills, bank statements, appointment letters and other documents with Adobe Scan. The app saves its high-quality scans in PDF format, and lets you organise items into folders and upload them to an online-storage service.

Best For: Reducing paper clutter

LINUX

Fast and easy image processing

Shashank Sharma dreams of achieving a leaner version of himself. Until then, he'll settle for an ImageMagick derivative that's skinnier, yet useful.

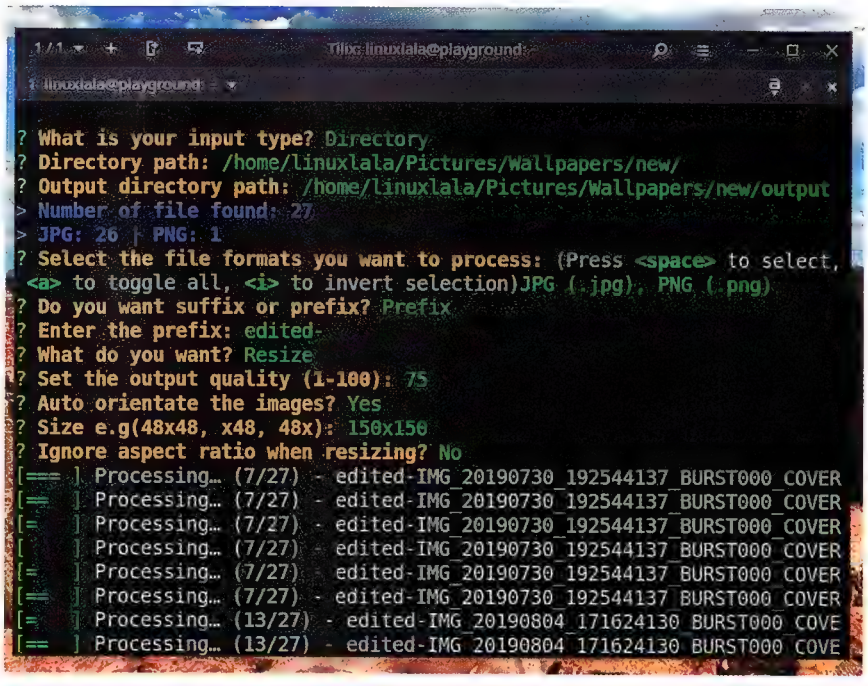
You wouldn't think of the command line as the go-to resource when it comes to image processing. After all, rotating, cropping, resizing and adding watermarks to images involves extensive mouse work. Or does it? ImageMagick has long been the tool of choice for users who don't mind working with the CLI and want a single tool that can perform all these operations and more, such as creating animation, adding 3D effects to images by adjusting shadows and lights, and so on. As useful as ImageMagick is, it can also be quite daunting for novice users, who feel overwhelmed by the incredibly feature-rich project that has inspired many graphical image-processing front-ends and is also the subject of various books.

Korkut is an ImageMagick derivative that offers only a handful of features, which makes for a far easier introduction to image processing on the command line. Released under the MIT licence, the Node.js project can be used to convert files between different formats as well as perform simple operations such as cropping, rotating, flipping and resizing images, and even adding a watermark to your files.

You won't find Korkut in the software repositories of your favourite distribution, but the installation is quite straightforward if you already have Npm, the Node.js package manager, installed. You can use your distro's software repositories for installing these. The command **sudo apt install nodejs npm** installs Node.js and the Npm package manager on Ubuntu, Debian and derivative distros. Fedora users can similarly run the **sudo dnf install nodejs** command, which also installs the Npm package manager.

You similarly have to install ImageMagick on your distribution if it's not already installed, before you can run the **sudo npm install -g korkut** command to install Korkut itself.

Because the project relies upon ImageMagick to perform the actual image processing, Korkut doesn't ship with a man page. If you need help with any specific operation, you have to track down the ImageMagick documentation for assistance.


? What is your input type? Directory
? Directory path: /home/linuxlala/Pictures/Wallpapers/new/
? Output directory path: /home/linuxlala/Pictures/Wallpapers/new/output
> Number of file found: 27
> JPG: 26 | PNG: 1
? Select the file formats you want to process: (Press <space> to select, <a> to toggle all, <i> to invert selection)JPG (.jpg), PNG (.png)
? Do you want suffix or prefix? Prefix
? Enter the prefix: edited-
? What do you want? Resize
? Set the output quality (1-100): 75
? Auto orientate the images? Yes
? Size e.g(48x48, x48, 48x): 150x150
? Ignore aspect ratio when resizing? No
[===] Processing... (7/27) - edited-IMG_20190730_192544137_BURST000_COVER
[==] Processing... (7/27) - edited-IMG_20190730_192544137_BURST000_COVER
[=   ] Processing... (7/27) - edited-IMG_20190730_192544137_BURST000_COVER
[   ] Processing... (7/27) - edited-IMG_20190730_192544137_BURST000_COVER
[=   ] Processing... (7/27) - edited-IMG_20190730_192544137_BURST000_COVER
[==] Processing... (7/27) - edited-IMG_20190730_192544137_BURST000_COVER
[=   ] Processing... (13/27) - edited-IMG_20190804_171624130_BURST000_COVE
[==] Processing... (13/27) - edited-IMG_20190804_171624130_BURST000_COVE

You have to turn to your file manager of choice to see the new file sizes after each operation because Korkut doesn't provide this information.

> "Korkut is an ImageMagick derivative that offers only a handful of features, which makes for a far easier introduction to image processing on the command line."

Helpful wizard

ImageMagick's logo is a wizard holding a wand. Korkut builds on this motif by offering a useful wizard that guides you through the different steps for performing the image-processing operation.

To begin, run the **korkut** command. The wizard asks you to select your input type using the arrow keys. Your choices are File or Directory. Select File if you only wish to edit a single image. The Directory option is for when you wish to bulk edit your files.

Irrespective of the choice you make, whether File or Directory, Korkut next asks you to specify the path to the input file or directory. Unfortunately, the Bash complete feature isn't supported by Korkut, which means you have to manually type the complete path to the file or directory. Next, you're asked to enter the path to the output file, and once again you have to manually type in the complete path. Korkut then prompts you to select the type of operation you wish to perform on your file.

Your choices are Optimize, Convert, Crop, Resize, Watermark, Flip and Rotate. Depending on your choice, the wizard continues to prompt you with further queries until it is ready to perform the operation.

```
$ korkut
Korkut Version: 1.2.0
ImageMagick Version: 6

? What is your input type? File
? Input file path: /home/linuxlala/Pictures/
Wallpapers/new/bridge-seas.j
pg
? Output file path: /home/linuxlala/
Pictures/Wallpapers/new/bridge-seas.
png
? What do you want?
  Optimize
  Convert
  Crop
```

```
  Resize
> Watermark
  Flip
  Rotate
```

The wizard provides a list of options, where applicable, starting with the **What Do You Want?** question. The questions are preceded with the ? symbol, while the available choices are preceded with >. Select the answer using the arrow keys and then hit Enter. The options automatically collapse once you've made the selection and the wizard moves to the next question.

Unlike ImageMagick, which requires users to know the different command options and arguments, and specify the applicable values for each, the Korkut wizard greatly simplifies the process by also suggesting the possible values for the different options. Even if the possible answers aren't provided, Korkut prompts you with the possibility if you enter an incorrect answer:

```
? What do you want? Rotate
? Auto orientate the images? Yes
? Background color: blue
? Degrees: -25
>> Enter a value between 1 – 360.
```

Select the Convert option when the wizard asks you What Do You Want? if all you want is to convert the file format. Korkut supports JPG, JPEG, TIFF, PNG, WEBP , BITMAP and PDF formats.

Bulk processing

It's also possible to perform the same operation on multiple images with Korkut. You must select the directory that contains all the image files and follow the wizard from there.

```
> Number of file found: 27
> JPG: 26 | PNG: 1
? Select the file formats you want to process: (Press <space> to select,
  <a> to toggle all, <i> to invert selection)
>· JPG (.jpg)
  • PNG (.png)
? Do you want suffix or prefix?
> Prefix
  Suffix
  No
```

The above code block features some of the questions and the available options that you encounter when performing operation on a directory.

When editing a directory, Korkut identifies the total number of files by the format, such as JPG or PNG, and then enables you choose whether you wish to edit all file formats, any one or multiple. The operation you select to perform next is applied to the selected files only. You can also choose to specify a prefix or suffix for files, so that the newly edited files can be distinguished from the existing files.

Korkut overwrites existing files without informing you or asking for confirmation. This is why you must be extra cautious when specifying the output file or directory name.

You have to exit Korkut or at least use a different image viewer to see if your chosen image processing operation worked as expected. If not, you can rerun through the steps by making the necessary changes.

As useful as the project is, Korkut hasn't seen an update in several years. While we would love for the project to incorporate an undo option, or at least an option to delete the newly created edited image if it doesn't meet one's expectations, such features are unlikely to ever be added.

In any case, you can definitely use Korkut to perform the limited operations with ease, without getting overwhelmed by ImageMagick's capabilities. ■

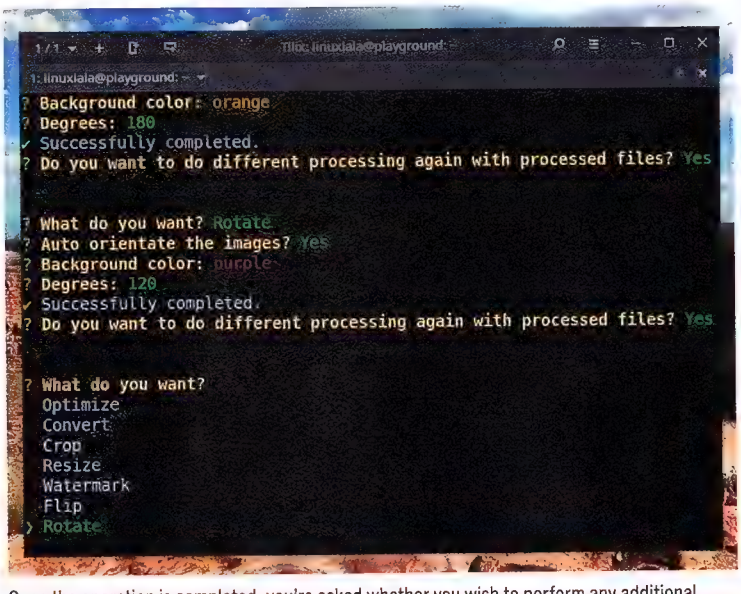
IMAGEMAGICK FRONT-ENDS

One of the reasons for the popularity of ImageMagick is the project's cross-platform support. You can run ImageMagick on Windows, Mac and BSD, as well as Linux distros.

There are also many graphical front-ends that use ImageMagick to perform image-processing operations, and some of these are also available as Flatpak or Snap packages, which makes them easy to adopt.

We've recently come across FotoKilof (**https://github.com/TeaM-TL/FotoKilof**) as well as Conjure (**https://github.com/nate-xyz/conjure**). Both these tools support most of ImageMagick's functionality and provide an easy-to-use graphical interface to help you transform your images. Although Conjure is still in beta, and neither project offers any meaningful documentation, the point-and-click nature of the tools should appeal to users not inclined or ready to spend time on the command line.

The ImageMagick project itself used to produce and support a GUI called Display, although it only supported version 6 of ImageMagick. With the project's transition to the newer version 7, the Display tool is deprecated along with the individual ImageMagick subcommands, which have been replaced with the magick command.



Once the operation is completed, you're asked whether you wish to perform any additional operations on the file. The process restarts if you answer yes and quits otherwise.

GENIUS TIP!

When specifying the background colour with the rotate operation, the colour changes to reflect your choice. In our case, the text "blue" changed to the colour blue, which is distinct from navy, royalblue, skyblue, and so on. We also tried orange, purple, white, black, grey and so on, and Korkut correctly identified each colour, changing the colour of the text to reflect our choice.

PI

Building a web-based robot control interface

In part five of his series, Les Pounder shows us how to build a custom web interface for controlling your DIY robot.

PART 5
Don't miss next issue, subscribe on page 20!

YOU'LL NEED THIS

- All of the code for this project, circuit diagrams and images can be downloaded from this GitHub repository: **https://github.com/lesp/Linux-Format-Robot/archive/refs/heads/main.zip**

By the end of part four, we had successfully built our robot from a kit, tested the motors and looked at a number of sensors, then we learnt how to use a Bluetooth controller. All of the previous parts are building up to our robot becoming complete in the final sixth part.

For this section of the build, we are going to learn how to use a free web service called Anvil (**https://anvil.works**). The Anvil service is where we can develop web apps in pure Python. Using an uplink, we will connect our robot to a custom-created web interface and then use that interface to control our robot.

> "As Anvil is based in the cloud, we can access and create projects from any web-enabled device."

This might sound a little scary right now, and while Anvil does have a learning curve, fear not! Anvil is extremely easy to use once you understand how it works. With that in mind, let's get started.

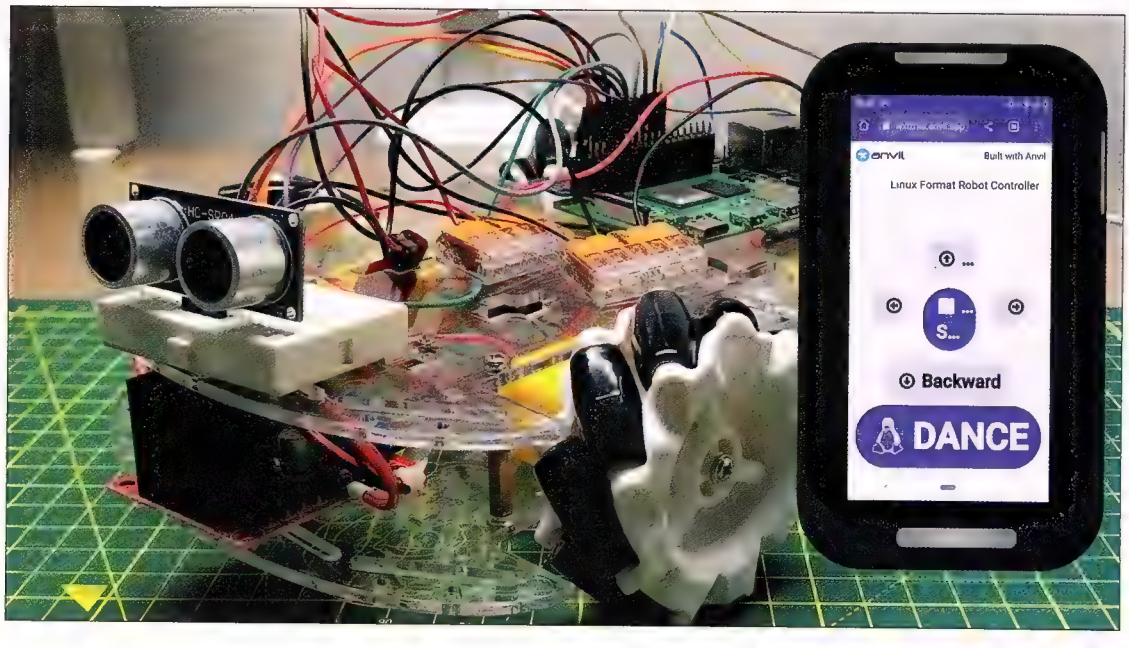
Hammer the Anvil

As Anvil is based in the cloud, we can access and create projects from any web-enabled device. As we're using a Raspberry Pi 4 for the robot, open a Chromium browser and visit **https://anvil.works/**. Click on Pricing or Start Building to sign up for a free account.

Anvil works by creating 'apps'. These are all web-based, and Anvil acts as an interface between us and our code. Anvil can be programmed to run code when a button is pressed, show an image captured on a remote device, store data in a database and many other services. Our need is simple: we want to press buttons and run code on our robot. To do this, Anvil has a clever uplink tool that securely links our robot to Anvil, where we can use buttons to send commands to the robot. To do this, we need to create a new blank app. Select Material Design 3 as the template and Anvil displays an interface that looks like Photoshop and an IDE blended together. By default, Anvil drops us into the Design tab, which is where we create a form that acts as the user interface for our app. We can change the view to Code, where we write the Python code, and Split, which splits the screen between design and code.

We start the design by going to the Toolbox, in the top-right corner. From there grab a Label (next to the pointer) and drag it into the design area. Drop the label on top of Drop Title Here. Now go to the bottom-right and look for Properties. Look for text and enter **Robot Controller**. Click on More and set the font to bold, and change the font size to 32. Our app title is now big and bold at the top of the form.

Our focus is on function for now. Our first goal is to create a button that acts as an input. From the Toolbox, drag a button and place it in the main area of the form. The form now has 'button_1' in place but we want to rename the button. Go to Properties and change the text property to read **STOP**. Set the text as Bold and set the font size to 32. This gives us a big button to press when our robot goes wild. Scroll down the



A custom web controller written in pure Python – with this we can easily control our robot from the comfort of our sofa.

Properties a little further and you will spot Icon. Here we can assign the button an icon, and luckily for us there is a STOP icon. Click on the Info button to the right of Icon and search for 'stop'. Finally go up and look for Appearance. Change the role drop-down to match your preference. We liked Filled-Button.

The button design is complete and now we delve into the code. Double-click on the button to start editing its code. This clever trick takes us to exactly where we want to be. We have a function, button_1_click, which reacts when we press the Stop button. Right now all it does is pass; if we replace **pass** with the following, it makes a call to our robot (Anvil calls this a server call, our Pi is a server) to run a function on the Pi. We haven't written this function on the Pi yet:

```
anvil.server.call('stop')
```

We're not done yet. Look to the top of the code, where the imports are located. We need to import the anvil.server module to enable our app to use the code we just wrote. Just under **from anvil import *** add:

```
import anvil.server
```

The code for the app is done for now, but next we need to enable the uplink. On the far left of the Anvil editor is a blue + symbol. Click on that and select Uplink. Create a server uplink. Keep the server uplink key on the screen for now.

Here is where we switch to writing code directly on the Raspberry Pi. But before we write Python, we need to install the anvil-uplink module via Pip. Open a terminal and use this command to install:

```
$ pip install anvil-uplink
```

Now, open Thonny and create a new file. We'll keep this simple for the test. We just want to check that our Stop button works at this point. First, we import the robots module that we created in previous parts. Then we import the anvil.server module. Lastly, we import pause from the signal module. This prevents the code from exiting:

```
import robot
import anvil.server
from signal import pause
```

Now we use the anvil.server module's connect function to connect our Raspberry Pi robot (remember Anvil calls this a server) to our Anvil app using our server uplink key. Refer to the Anvil app uplink page for the key:

```
anvil.server.connect("YOUR ANVIL SERVER UPLINK KEY")
```

Next we use a decorator to instruct Anvil that this is a function that it will use in the app:

```
@anvil.server.callable
```

Then we create a function called stop, and in there we call the stop function from our robot module. We then print **Done** to demonstrate that this function worked correctly.

```
def stop():
  robot.stop()
  print("Done")
```

Lastly, we use **pause** to prevent the code from exiting:

```
pause()
```

Save the code in the same directory as our robot module (**robot.py**) as anvil-test.py and click Run. Go back to Anvil, close the Server Uplink Key screen to return to the code editor. Click on the Run button at the top of the screen. Your Anvil app and robot are now connected. Keep the Thonny and Anvil app windows open and click on the Stop button that we created. You'll see the Python shell prints **ALL STOP** then **Done**. This proves that we can connect the app to the Pi, and we can now move on to creating buttons to control the robot.

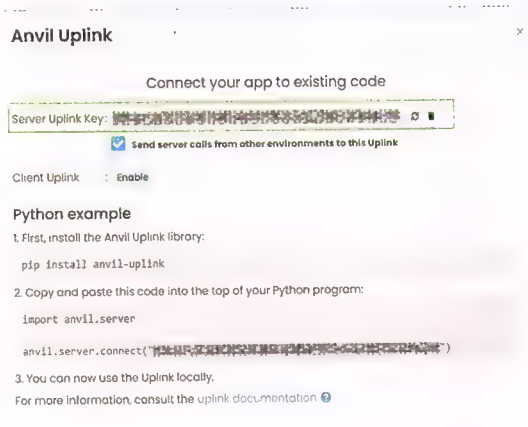
The robot controller is simple to use, with big buttons for easy input. The biggest button triggers the robot to dance at our command.

User interface

We're not just going to drop buttons all over the app. We're going to add a layout grid that

GENIUS TIP!

Your Python app can be shared privately for testing purposes, or it can be made public. The Publish button has options to create a URL with the correct sharing permissions.

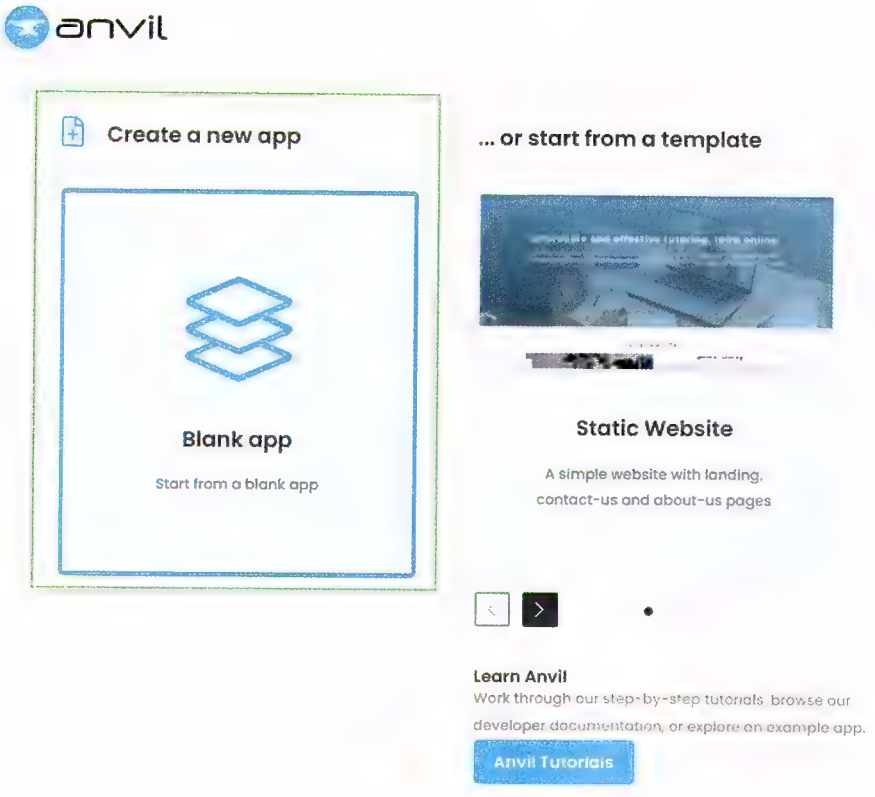

Anvil Uplink
Connect your app to existing code
Server Uplink Key:
Send server calls from other environments to this Uplink
Client Uplink : Enable
Python example
1. First, install the Anvil Uplink library:
pip install anvil-uplink
2. Copy and paste this code into the top of your Python program:
import anvil.server
anvil.server.connect("
3. You can now use the Uplink locally.
For more information, consult the uplink documentation

The server uplink key is a means to communicate between our Anvil web app and the code running on our robot.

ANVIL AND THE RASPBERRY PI PICO W

The Raspberry Pi Pico W, released in June 2022, saw the RP2040 microcontroller gain Wi-Fi and Bluetooth connectivity. Just a couple of days later, Anvil released its flavour of MicroPython with built-in support for its uplink. Yes, the same robot that we built with a Pi 4 could be built with a $10 microcontroller and Anvil's free web service.

To use Anvil with the Pi Pico W, we download a special version of MicroPython and edit a file on the Pico W's root filesystem, boot.py, to include our Wi-Fi details. Then we need the Anvil uplink key to connect our Pico W to Anvil so we can send data between the two. If you'd like a project to follow, the **Tom's Hardware** project at **www.tomshardware.com/how-to/build-raspberry-pi-pico-w-web-app** details how to create a web app to update an LCD display connected to a Pi Pico W. The web app handles capturing messages from the user, and with a click of a button, the message appears on the LCD screen, just as we sent movement controls to the Pi robot.


anvil
Create a new app
Blank app
Start from a blank app
... or start from a template
Static Website
A simple website with landing, contact-us and about-us pages
Learn Anvil
Work through our step-by-step tutorials, browse our developer documentation, or explore an example app.
Anvil Tutorials

Anvil calls our robot controller an 'app' and it treats the code as a web app, with all of the code running on its services.

holds the buttons in place. From the Toolbox, click on See More Components and drag a Grid Panel into the design area. Place it underneath the Stop button. The grid has many slots within it. In there we can drop many different buttons. But first, place the Stop button in the centre. It doesn't have to be perfect, we can tweak it as we go. Drag another button and place it inside the grid, but above Stop. In the properties, change the text to Forward, then click on More to see more text options. Change the font to bold, set the size to 32 and then change the icon to show an upwards pointing arrow.

> "First, place the Stop button in the centre. It doesn't have to be perfect, we can tweak it as we go.

Remember to go to Appearance > Role to match or complement the Stop button. We found that the Tonal-Button role provided a nice contrast. With the button created, we need to double-click on the button and edit the code. The code editor takes us straight to where we need to be, just replace the `pass` with the following code.

```
anvil.server.call('forward')
```

Now let's jump back into the Python code in Thonny. Create a new function called forward underneath the previous function. Again, we need to use a decorator to tell Anvil that this is a function that it should run. The function calls our robot module's forward function and for now we set it to half speed. We also add another `print` function to show that it is working:

```
@anvil.server.callable
def forward():
  robot.forward(0.5)
  print("Moving forward")
```

Save the code and click Run in Thonny. Now go back to Anvil and click Run to start the app. The two will connect with each other and we see the Forward button in the user interface. Keep the Thonny and Anvil windows open and click on Forward. Note that Thonny's Python shell shows that the command was successful.

Repeat adding a button to the user interface three more times. For backward, right and left. We won't repeat the design steps, but here are the code snippets for clarity:

For backward, here is the code for the Anvil app. Remember to double-click on the button to go straight into editing the code:

```
anvil.server.call('backward')
```

Here is the Thonny Python code required for the backward function:

```
@anvil.server.callable
def backward():
  robot.backward(0.5)
  print("Moving backward")
```

Here is the Anvil code for the left button:

```
anvil.server.call('left')
```

Here is the Thonny Python code for the left button. You need to import the time module in order to pause the code. Go to the top of the file and add this import:

```
import time
```

Note that this spins the robot left, so we add a half-second pause, then stop the motor. Keep pressing the button to spin further:

```
@anvil.server.callable
def left():
  robot.spin_left(0.5)
  time.sleep(0.5)
  robot.stop()
```

ANVIL ALTERNATIVES

We enjoyed using Anvil to create a web interface for our robot. Chiefly because it was so simple. We didn't have to worry about HTML or CSS, we just wrote Python and moved a few buttons around a layout. Anvil did the rest for us. That said, we can easily add a little CSS or custom themes to make our app perfect. But, Anvil is not the only way to generate a control interface for our robot. We could use Flask, a micro web framework for Python that can be used to generate a web app. We would need to generate the HTML and CSS for the app, but this isn't too difficult to achieve.

Another alternative is Kivy, a framework to create cross-platform apps that can even run on Android and iOS devices.

Another alternative is Node-RED – while not Python based, we can use nodes (Node-RED commands) to execute commands on the terminal or in a Python session. With this we could easily create a web interface directly on the Pi. The beauty of Linux and Python is the choice. We are free to approach the project from any angle, solving issues as we meet them using great open source tools.

```
  print("Spin Left")
```

Here is the Anvil code for the right button:

```
@anvil.server.callable
def right():
  robot.spin_right(0.5)
  time.sleep(0.5)
  robot.stop()
  print("Spin Right")
```

Our final test is to make the robot dance. Yes, you read that right – we're going to have the robot perform a series of manoeuvres when the Dance button is pressed.

Add a new button below the grid. Change the name of the button to **DANCE** and set the text to bold, and this time set the size to 64. We chose the Appearance > Role of Filled-Button and from the Icons list we found a charming image of Tux, the Linux mascot. Double-click on the button and replace **pass** with the following code:

```
anvil.server.call('dance')
```

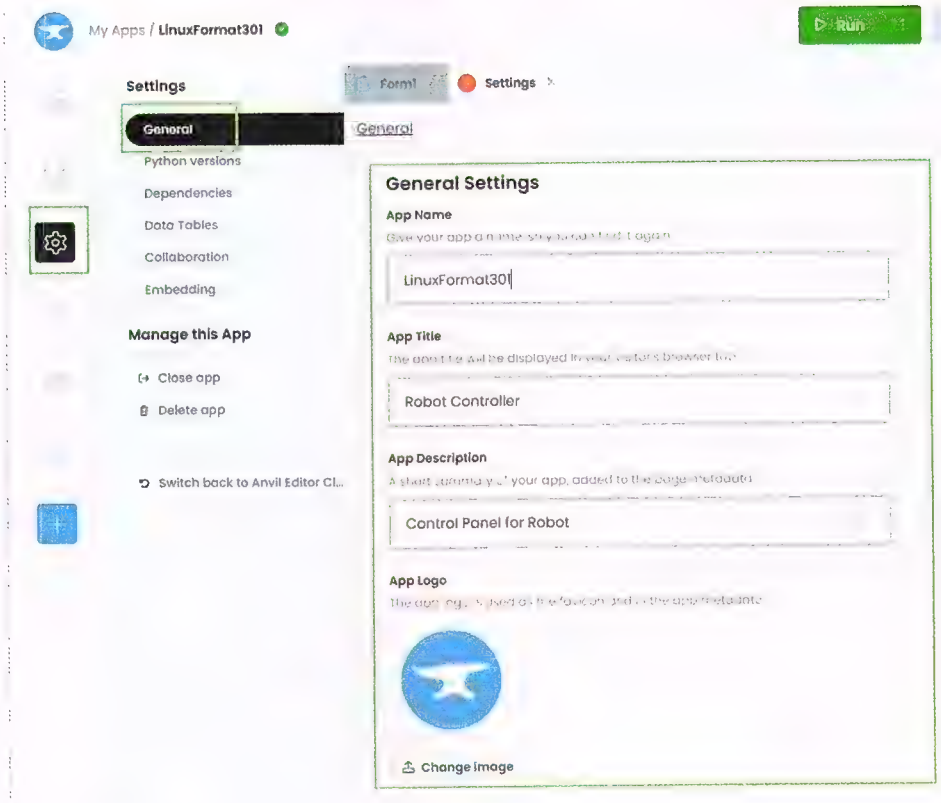
Now go back to Thonny and create the dance function, and in there store a series of movements for the robot to undertake. Ensure there is a delay between each movement, otherwise your poor robot will breakdance. We used a for loop to repeat the dance steps three times:

```
@anvil.server.callable
def dance():
  for i in range(3):
    print("Forward")
    robot.forward(0.5)
    time.sleep(2)
    print("Spin Right")
    robot.spin_right(0.5)
    time.sleep(1)
    robot.stop()
    time.sleep(0.5)
```

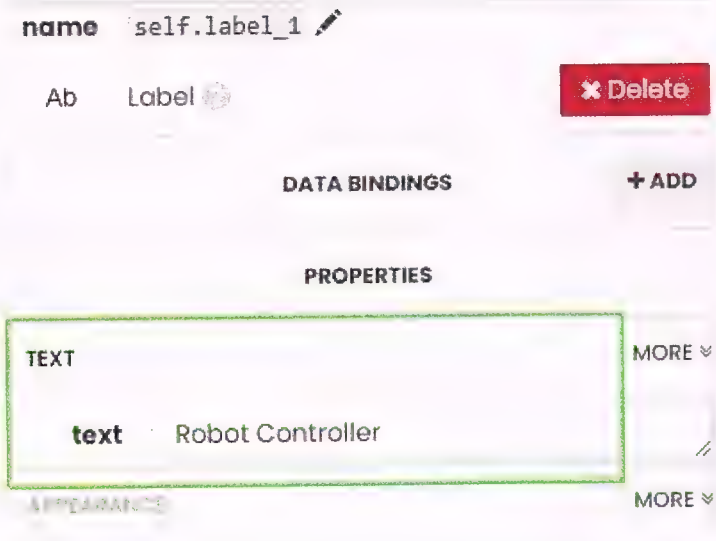
Save the code and click Run to start. Now go to Anvil, start the app and press the big DANCE button!

Sharing your controller

Anvil has a handy feature where we can share the app as a URL. Just next to the Run button in the Anvil editor is Publish. Click on Publish and in the new dialog we can either have a private URL or public.



Under Settings > General, we can give the app a name, description and a funky logo.



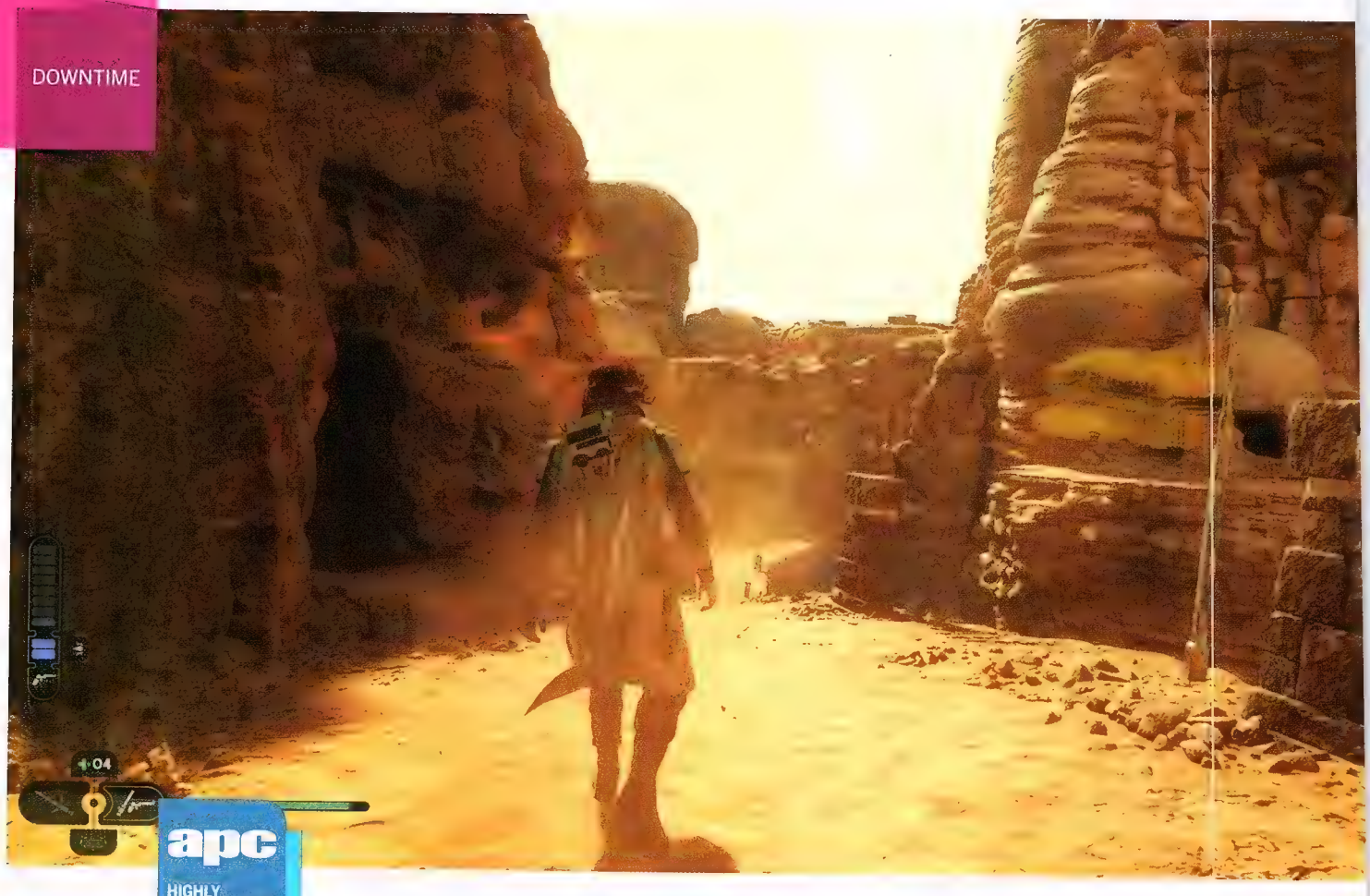
The toolbox has a number of features. In this case, we are looking for the icon that inserts a button that can be used to send a command to the robot.

The private URL generates a URL that is private between you and those who you choose to share it with. As this is a URL, we can access it from any web browser, from any location around the world. Fancy driving your robot from the beach or your office? You can also generate a public URL. Rather than a mix of letters and numbers, this is a series of easy-to-remember words that we can give to friends who want to try out our robot controller. URLs can be removed should someone get a little too excited controlling your robot.

All of our hard work has paid off with a great web user interface, an interface that we can use via our computer, tablet or smartphone. We can control the robot from the other side of the room or the world! Anvil is a great way to build controllers for all sorts of applications, and in the next and final part of this series, we will delve a little deeper into Anvil, and use it to show images from a camera attached to the robot. For now, take a look back at how far we have come. From a plastic robot chassis and some electronics, into a fully functioning web-controlled robot. All we needed was a little code, time and a few components to build a four-wheeled-drive robot. ■

GENIUS TIP!

Anvil uses pure Python to write apps. This means we can create entire sites using nothing but Python. Anvil can be used to write ecommerce applications, user interfaces and UI for Python tools gathering data.



apc HIGHLY RECOMMENDED

GAMES

Star Wars Jedi: Survivor

A grand sequel with Souls-like action.

■ $99.95 | PC, PS5, XBS/X | ea.com/games/starwars

Jedi: Survivor bucks the recent trend of dull Star Wars TV content. It's one of the best things to happen to the series in years, and easily the best modern Star Wars game.

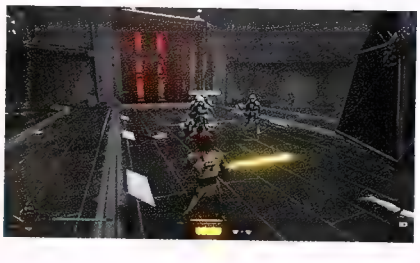
At a glance *Jedi: Survivor* seems like it falls squarely on the pulpy, safer side of Star Wars – the gifted Jedi with untapped potential, faithful droid companion, and swashbuckling crew certainly paint that picture, but there's more to Cal Kestis. *Jedi: Survivor* doesn't shy away from the darkest chapter of Star Wars history, but finds humour in an unfair world and sometimes succumbs to helplessness.

It's not a story about fighting the Empire as much as coping with its dominance, grappling with the futility of rebellion and questioning what's left to fight for. The modern Star Wars media that this feels closest to is Andor, though it's not as ambitious in its storytelling or as cynical. Unfortunately, those themes take a backseat through the middle of the story while Cal Kestis and crew entertain the deranged tantrums of a skin-deep evil guy with a red lightsaber, reminding us that this is still Uncharted in space.

Much of *Jedi: Survivor*'s platformer spirit is felt in its hub world of Koboh, a frontier planet in the midst of a turf war between Stormtroopers and raiders wielding reprogramed prequel droids. You might be surprised to find out that half of the game takes place on Koboh, but that's because it's packing multiple full-sized levels, sidequests, secret areas, puzzle rooms and optional boss battles. It's deep, wide, and technically an open world, but not a boundless sandbox. It's more like a collection of linear levels connected to a central area like spokes on a wheel – a PS2-style platformer without the loading screens.

The one aspect of *Jedi: Survivor* that hasn't been reimagined, but didn't really need to be, is combat. It has been enhanced, though, and is even better now that droids are in the mix. Cal has gotten a lot more lethal with a saber in the five year time skip – limbs are chopped off from heavy attacks, giant bugs can be entirely bisected, and sometimes Cal will unholster his blaster for a finishing execution that I assume he learned watching *John Wick*. Oh right, Cal has a blaster now. It's one of the two saber stances new to *Jedi: Survivor*, for a total of five: single saber, double-sided saber, dual saber, blaster and crossguard. I'm impressed at how Respawn has managed to make what is essentially the same saber feel like five distinct weapons.

Jedi: Survivor is a bigger, bolder game than its predecessor that prioritises tight level design over map scale, a rarity in an age of sprawling sandboxes. This is Respawn firing on all cylinders, having finally figured out what works in its weird Souls-like adventure format.



Star Wars Jedi: Survivor is an excellent sequel, but maybe wait for a few patches for better performance.

Morgan Park

★★★★☆

AGE OF WONDERS 4

Makes conquering worlds with magic a joy.

■ $69.95 | PC, PS5, XBS/X | paradoxinteractive.com/games/age-of-wonders-4

Age of Wonders 4's structure should be familiar: you start with a single city, erect new buildings, develop the surrounding provinces, recruit armies and explore the map to find treasure and new enemies. Resources like food, gold and mana must be managed, rival rulers can be engaged diplomatically or aggressively, and eventually you'll start working towards one of the victory conditions, perhaps focusing on magic, or maybe just conquering everyone.

But the latest game in this long-running series is still distinct from both its forebears. It makes this clear right away, when you pick the foundations of your magical empire. First, there's the map. There's an abundance of premade maps, including ones that are part of the story-driven campaign, but you can also spawn your own, selecting its traits.

Nearly as important is the creation of your ruler. If you pick a mortal champion it will be from the same species you just created, while Wizard Kings can be from any species.

Instead of a conventional research system, *Age of Wonders 4* doles out tomes of magic, each containing a variety of spells. Tomes are connected to the game's cosmic affinities, like order, chaos, nature and so on. By researching spells from these tomes, and unlocking new tomes, you'll rather quickly find yourself with a rich bounty of city enhancements, summons, transformations and enchantments, as well as all sorts of defensive and offensive spells.

The result is a more approachable *Age of Wonders*, but it should be noted that streamlining is not the only way that Triumph has achieved this. There's the helpful nested tooltips, a codex and a hint system that should make your life easier, but also mechanical improvements.

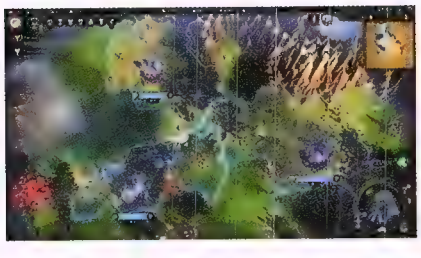
> "The latest game in this long-running series is still distinct from both its forebears."

With all the ways you can develop your empire, *Age of Wonders 4* demands to be played over and over. *Age of Wonders 4* scratches my itch for experimentation like few other strategy games, seducing me back to drag my empire in new directions.

Age of Wonders 4 is flavourful and inventive 4X full of incredible spells and engaging empire management.

Fraser Brown

★★★★½



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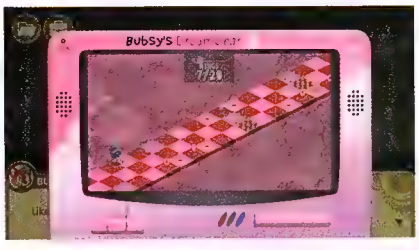
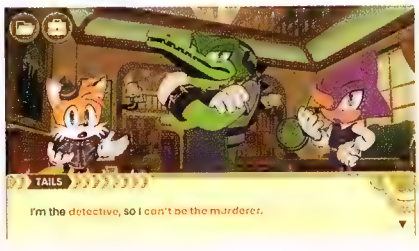




THE MURDER OF SONIC THE HEDGEHOG

Less jumping, more murder.

■ Free | PC, Mac | bit.ly/MurderSonic

Sonic has been murdered – well, not really – and it's up to Tails, I guess, to finger the suspect from a cast of his anthropomorphic mates. This is an affectionate visual novel that redeems an oft-maligned band of mascots.

It's also, of course, a joke game – an exceedingly polished one – released on April 1, for free, on Steam. Set aboard a luxury train where Amy Rose has organised a murder mystery party, you have to solve the murder of Sonic the Hedgehog – who has really been attacked and rendered unconscious – by examining clues in each train carriage, and interrogating such suspects as Knuckles and Rouge the Bat.

While there has been no actual murder, this is still a tightly designed mystery complete with maps and alibis that need to be rigorously checked. You can pick the wrong dialogue options, but with no real consequences, as Tails the Great Detective will just gently correct you. Nevertheless, you still feel involved in the story, because you're being asked for your opinion all along.

A fun, if slight, mystery made with genuine love for the world of Sonic.

Tom Sykes

★★★★☆

UNCHARTED WANDERS

Crawling for cash.

■ Free | Browser | bit.ly/UnchartedWanders

Created for this year's Dungeon Crawler Jam, *Uncharted Wanders* is in fact a game about dungeon crawling to turn a profit, as you lug goods from one town to another. They might only be minutes apart from each other, but monsters are a persistent hazard on the grid-based pathways.

Everything in the world is geared towards the trading business. The Ministry of Trade sells licences that determine how many hired hands you can bring with you, while the only things the shops sell are trading goods and exploration supplies. Mapping the dungeon is really a by-product as you shift table legs from Physopolis to Spiriton on the reverse journey.

The traditional crawling experience has been ruthlessly streamlined here. Combat is automatic, as you step next to the enemy, with a trio of stats resolving combat in a deterministic way. There's no way to heal, other than to find a town, while the supplies are only used to mend broken bridges. But there's a lot of game here, far more than I've come to expect from a jam game.

Uncharted Wanders feels extraordinarily good to play.
Tom Sykes

★★★★☆

TERRA NIL

A soothing, satisfying and educational environmentalist puzzler.

■ $36.99 | PC, Mac, IOS, Linux | terranil.com

Officially billed as a 'reverse city builder', it's not inaccurate to describe *Terra Nil* as such. It's a game about spending and generating resources, building synergistic chains of structures to achieve numerical goals. Despite this, *Terra Nil* owes more to puzzle games and solitaire than anything else.

Terra Nil is a meditation on what we – as a species – owe to our world. You're not building for profit or victory, but restoring a barren, toxic wasteland to life, reintroducing animals before cleaning up your own mess. Turns out that restoring beauty and then tidying up is a surprisingly compelling loop for a game.

> "Finding the tricks in each environment to nudge nature into doing the heavy lifting was always satisfying."

Terra Nil is surprisingly slight and focused. There are initially only four missions played in order, each taking place in a different procedurally generated environment. The environments require distinct techniques and equipment to revive, each providing a different palette of tools and structures to use.

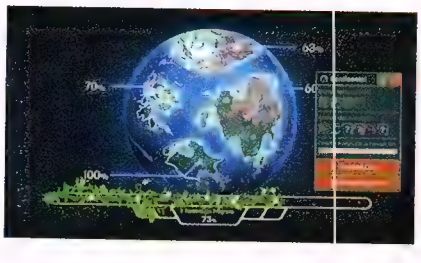
Terra Nil conveys its message through mechanics. Brute force works, but it's more efficient to work with nature. Cloud Seeders near bodies of water won't do much at first, but the rising humidity will kickstart natural rains, cleansing the entire map if you're willing to just sit for a while and let nature take its course while enjoying the rain.

That's where the joy of *Terra Nil* lay for me. Finding the tricks in each environment to nudge nature into doing the heavy lifting was always satisfying. A well-placed water pump on a hill can fill multiple rivers and lakes. A controlled wildfire can create fertile ground for an entire forest. You're kickstarting natural processes again, not building a base, and perhaps learning a bit about how these environments formed.

Terra Nil's themes are reflected in its design; as much fun as you might be having, sometimes it's best to just clean up when you're done and move on. Not everything has to last forever or grow endlessly. Bowing out brings its own satisfaction.

A small but satisfying strategy puzzler that comes, does its job, and then leaves without fuss.
Dominic Tarason

★★★★☆



MINECRAFT LEGENDS

An action strategy spinoff that fails both genres.

■ $49.95 | PC, PS4/5, XB1/S/X, Switch | minecraft.net/en-us/about-legends

Minecraft Legends captures the flavour of standard *Minecraft* well: the action strategy spinoff has a familiar art style, a colourful world, and a procedural map. It doesn't bring along *Minecraft*'s substance, though, and the result is a genre mashup that's disappointing as an action game and as a strategy game.

Legends has avoided calling itself a real-time strategy game, opting instead for 'action strategy' because I have control of my own hero character and command my units from the ground rather than a godlike RTS perspective. Ultimately, *Legends* has wound up with a style of combat that serves both action and strategy poorly; it requires intense micromanagement without actual strategic depth.

The only 'action' in this combat is using a single button to swing my sword back and forth, tickling piglins away from my defensive structures. The strategy bit is worse: an unending escort mission that forces me to play helicopter parent to my own armies. I can create slightly specific orders by asking only ranged mobs to target a lava launcher enemy while asking my cobblestone golems to defend a hole in my outer wall. If I want to redirect them, I have to physically ride over, wave my flag to lure as many as I can reach, and ride away to point them in a new direction. There is no overhead strategy view for short-handing this process. Many small piglin outposts require me to build ramps so my mobs can reach enemy structures and I often find them standing beneath a ramp after being knocked off a platform, forcing me to shepherd them back to their target.

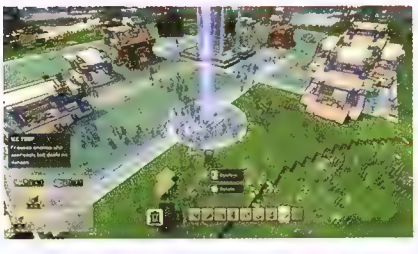
> "The only 'action' in this combat is using a single button to swing my sword back and forth, tickling piglins away from my defensive structures."

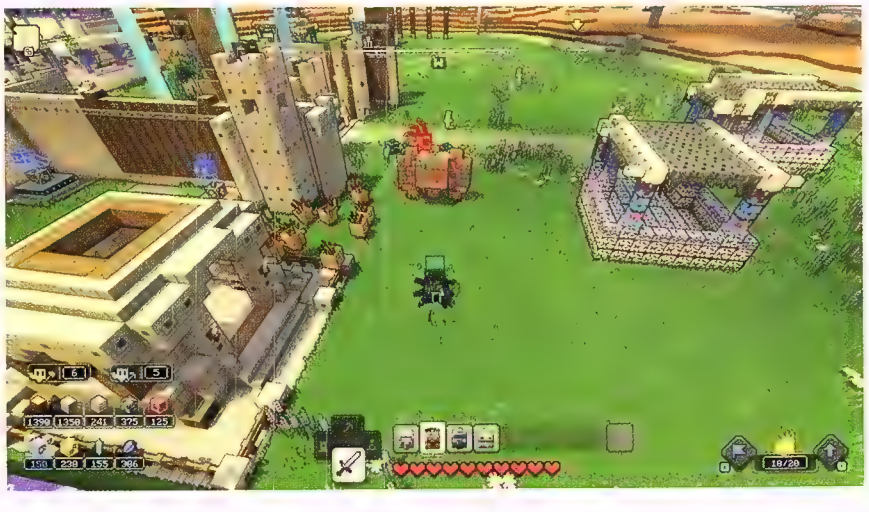
Coming up with interesting strategies feels pointless because *Minecraft Legends* lacks the tools I'd need to enact all but the simplest plans. The worst part is that *Minecraft Legends* didn't have the decency to be a dumpster fire. As a piece of software, I've got no complaints, but it's a disappointing game. *Minecraft*'s values of creativity and player choice didn't make it into this spinoff.

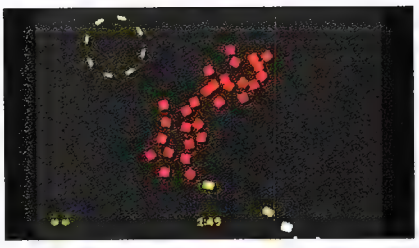
An action strategy spinoff that disappoints both genres and misses *Minecraft*'s magic.

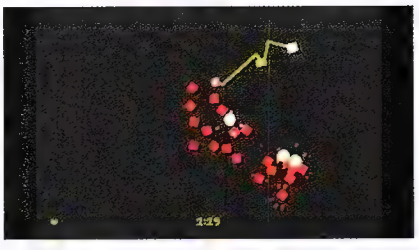
Lauren Morton

★★☆☆☆









DRIFTR

Hectic top-down survival action.

■ Free | Browser | bit.ly/driftrGame

Driftr is a *Vampire Survivors*-like, meaning you'll be fending off waves of enemies and carefully curating a character build, as a timer ticks away. However, you're only being asked to survive for a piddly three minutes here. Child's play. No, I haven't managed it. *Driftr* is hard.

Where it differs from the rest of the genre is the nature of character movement. As if you're steering a car, you direct the plain white block protagonist by using the Left and Right arrow keys. The block will accelerate automatically, but you can also activate a hard-to-control boost by holding either key down.

You begin by simply dodging enemies, which is tricky enough, before the temporary green and yellow zones are introduced. Successfully steer into a green zone and you'll get a blob of health, while yellow ones will grant a choice of power-up. 'Better handling' felt essential, but you can also find abilities that trigger explosions as you get hurt. You're trying to combine complementary power-ups that will allow you to last the three minutes, or as long as you possibly can.

An enjoyably brisk *Survivors*-like, with a minimalist aesthetic.

Tom Sykes

★★★☆☆

GAME CHANGER

Prince of Persia

An attempt to find a path for the Prince. By Robin Valentine

■ **Release:** December 9, 2008 **Developer:** Ubisoft **Publisher:** In-house **Link:** ubisoft.com

By the late 2000s, the *Prince of Persia* series was already on its way out. 2008's entry, simply titled *Prince of Persia*, wasn't quite the last gasp, but it was the last attempt at forging a real future for the series – a reboot that took big swings in an attempt to update the formula.

Though well received critically at launch, it doesn't hold much of a place in the heart of your average *Prince of Persia* fan – but I've always had a soft spot for it. That fondness has only grown as modern videogaming has gradually dumbed down traversal. Sure, *Assassin's Creed* still lets you climb any building you like, but all you're doing is pointing in a direction and holding down a button. The *Prince of Persia* series was all about embracing the fun of leaping, swinging, clambering, and wall-running for its own sake, and in my memory the 2008 game was the exemplar of that – the moment *Prince of Persia* focused most strongly on that core identity.

But, memories can be flawed. With the *Sands of Time* remake in theory on the horizon, it seems the perfect time to give *Prince of Persia* 2008 a reinstall, and find out how rose-tinted my recollections are.

Flirt locker

The game still makes a strong first impression. To say it holds up visually is an understatement – thanks to a rich, cel-shaded art-style and lavish environmental design, it remains absolutely gorgeous. You know when you see some amazing concept art from a game and think, "I wish the final thing looked like that,"? *Prince of Persia* 2008 is the game that does.

Set across an ancient city, it takes every opportunity it can get to show you a huge edifice in the distance. The sense of scale is wonderful – and it's the perfect pairing with a game about climbing. Every time you spot some far-off structure, you know you'll be making your way to the top of it before too long.

Above: The painterly look ensures it's barely aged at all visually – particularly in its sweeping vistas.

The two lead characters have aged rather less well. With his generically handsome mug, Nolan North voice, and endless sarcastic quips the rebooted Prince couldn't be more of a late-2000s videogame protagonist. His constant companion Elika is a sexy fantasy girlfriend who's sassy and self-confident yet regularly faints into the Prince's arms thanks to her taxing magical powers. The majority of the game's story simply consists of listening to these two cardboard cutouts awkwardly flirt.

Partners in time

But while their dialogue may be grating, they do work well together as climbing partners. You control the Prince, but Elika is always close behind, and as you progress you

become able to use her magic in your traversal. The movements of the two side by side are wonderfully smooth as they nimbly swap places on a beam or climb past each other up a wall, and invoking Elika's powers is seamless. It really is an impressive feat of animation.

Their joint goal is to cleanse this fallen city of a supernatural corruption that has swallowed it up – oily gunge and undead monsters everywhere. By parkouring around the ruins, you're able to reach 'Fertile Grounds' – points that, if cleansed, will heal and transform the area around them, restoring its greenery and clearing it of traps and enemies.

All of these areas are interconnected, forming what is effectively a continuous open world – and you're free to tackle its Fertile Grounds in pretty much any order you like. It's a big departure from the more linear *Prince of Persia* games that preceded it, and it does make you feel all the more a master of your environment that you're able to carve your own path through the world.

Above: The Prince is never actually named, or even confirmed to be a prince – his backstory is left intentionally obscure.

Swing city

The problem is, it means the game can never really build on its ideas. Because the developer can't know what order you're going to play the levels in, nothing can ever really escalate or evolve. The core action is rich and fun – in the rhythm of stringing together acrobatic moves, relying on both reflexes and forward planning as you chart your path, it's a blast. But the difficulty curve is, by necessity, almost completely flat.

As I remembered, the platforming is the star of the show, but even here you can see the drift towards streamlining and simplicity. The game finds its sweet spot of difficulty, and essentially stays there for its entire ten-hour runtime, but even within those bounds, it seems oddly afraid of letting your failures have any consequences – any time you fall, Elika uses her powers to save you.

The same applies to the game's oddly experimental combat. Fights

AFTER THE ENDING

Technically, the story didn't stop there

EPILOGUE

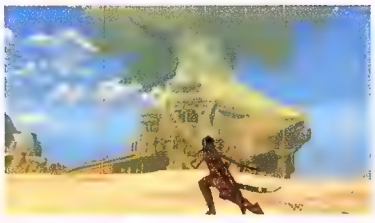
Annoyingly, the game has a DLC epilogue that has never been made available on PC. Not much happens in it though, other than Elika being annoyed at the Prince for, y'know, dooming the world to darkness for her.

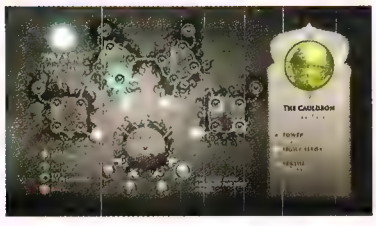
PRINCE OF PERSIA: THE FALLEN KING

A sequel was released the same year for the Nintendo DS, sidelining Elika so the Prince could adventure with a ghost king. The reboot series' story ended here, with another cliffhanger.

PRINCE OF PERSIA: THE FORGOTTEN SANDS

Though it was developed alongside the 2008 reboot and timed for release with the 2010 movie, this game has no story ties to either, instead taking place between *Sands of Time* and *Warrior Within*.





Another experimental flourish is a final boss fight played entirely from the boss' first-person perspective.

Above: Each node on the map is a Fertile Ground – you're free to work your way between them as you wish.

Right: Elika's magic allows her to cleanse the Fertile Grounds, though the effort tends to make her swoon into the Prince's arms after.

aren't really the strong suit of any of the *Prince of Persia* games, and as part of this one's quest to refocus the series' identity, it streamlines them down into a sort of tug of war rhythm game where you try to string together button combos to unleash canned animations. Your attacks push up a meter, and your enemy's push it down – you have to fill it up to the end to defeat them. Let it drain completely and... well, Elika saves you. You have to admire its strangeness – I don't think it's quite like anything before or since – but it's quite toothless.

Weighing up its flaws, I have a moment of doubt – was my nostalgia for *Prince of Persia* misplaced all these years? But I press on, and my fears are soon put to rest. Despite its stumbles, it's still fun traversing its beautiful spaces like a sight-seeing spider monkey. After so many modern games have rendered the act of moving through and around a space uninteresting, it's a joy to return to an era where it could still be the best part of the experience.

Fit for a prince

At first intending just to explore for a few hours, momentum soon carries me right through to the finish. I'm glad it does, because I get to re-experience *Prince of Persia*'s most fascinating element of all: its ending. Be warned, spoilers for a 15-year-old game follow.

As you explore the city and cleanse its corruption, restoring it to beauty and safety, the reason behind the corruption is left unexplained, the only hint being clashes with Elika's corrupted father that suggest it was somehow his fault. Regardless, your mission is clear – you keep healing Fertile Grounds, and eventually the final one is cleansed. It's a moment of real satisfaction, the lush visuals rewarding you with a sense of a land truly restored to beauty.

It's at that point that you discover the truth: the transgression that doomed the land was Elika's resurrection. She died, and in his grief her father made a pact to bring her back, unleashing the corruption. To fix that mistake, she must give up her life once again.

She dies, and the Prince carries her body to its resting place. But the game just keeps going. Quietly, the realisation dawns on you of what the game wants you to do next. After ten hours of blossoming romance, the Prince can't let sleeping princesses lie – in order to see credits, you need to make the same terrible pact her father did.

You trudge step by step to the four magical seals that hold back the corruption, and break them – methodically undoing everything you've achieved. By your hand, the corruption returns, and the hard-won beauty dies away. It's a shocking and affecting moment, all the more so for making you take the heartbreaking steps yourself rather than simply watching them play out.

As an ending, it's a very bold swing – which makes it the perfect capstone for a game even more experimental than I remembered. For all its awkward attempts to find a new mass audience for the series, with focus-grouped banter and forgiving difficulty, it's a game that takes a lot of risks too. In the end, it wasn't successful in finding a future for *Prince of Persia*, but it's a testament to its spirit that in 2023 it's still an impressive piece of work, not just a historical curiosity. For better and worse, true originality always stands the test of time. ■

RETRO

The 16-year review: Asus Eee PC 701

It was as small as a hardback book, but Asus' ground-breaking netbook was given a big five stars when it was reviewed in APC 16 years ago. David Crookes takes a fresh look.

I can vividly recall the moment when I first took the Asus Eee PC 701 on a trip. It was 30 October 2008, 21 days after it had been delivered, and I was on a train and my job was to report on a game festival packed schedule of events for a magazine called GamesTM which, incidentally, would publish its final issue exactly ten years later. On the way, I thought I'd make some notes, so I opened the computer on the train. Suddenly, multiple eyes stared at me.

"What's that?" asked a fellow passenger. "That's a tiny one," offered another. "I bet it's expensive – look at how neat it looks," quipped a third, mouth munching on a biscuit, leaning over for a closer look and blasting a few crumbs in my direction.

Suffice to say I didn't get any work done on the train that day, but Asus may well have gone on to sell a few more of its affordable sub-notebooks. Its unique selling point – a footprint of 225 x 170mm – practically defined the word "ultraportable". This, combined with a weight of only 928g, justified the admiring glances.

The Eee PC 701 was – and is – a beautiful-looking computer; a considerately angled device in a

The device can run other OSes, including Ubuntu Network Edition.

solid casing finished in pearl-white gloss. It was the kind of device that reviewers dub "sexy". It was also practical. Having spent the days note-taking, I'd pop the 701 on the desk in my Travelodge room and bash out some articles. I recall it working rather well.

But that was 15 years ago. The Eee PC 701, launched a year before, had been inspired by One Laptop Per Child, a non-profit global initiative that led to the creation of the $100 OLPC XO. But how would it fare today?

As luck would have it, I was recently rummaging through my cupboards when I spied an Eee PC computer box behind another load of long-abandoned tech. I eagerly opened it and felt relieved that the device was inside. What's more, it looked as good as it did the day I bought it, possibly because it didn't get used much beyond 2011 when the netbook era was coming to a close. Time, then, to put it back to the test.

After inserting the battery pack and connecting the power adapter, I powered up the device, but things didn't go 100 percent smoothly. The device made a whining noise, paused, then told me the CMOS settings were wrong; the fix involved resetting the time and date in the BIOS setup utility. My brain then froze when asked to enter the device's password. The Eee PC required a factory reset!

Within a few minutes, I was up and running and faced with a Xandros installation of Linux. Given the low price of this particular Eee PC (you could pick one up for about $499 at launch), it was no surprise – whether back then or today – that Windows wasn't installed. Its 900MHz Intel Celeron-M CPU and 512MB RAM was certainly capable of running it, but the tab-based Linux alternative shaved off some of the cost.

Each of the tabs displayed a range of apps. The Internet tab appeared immediately, offering the prospect of browsing the web, checking emails, using Skype, opening Google Docs or looking at Wikipedia. By selecting Work, you could choose between a word processor, spreadsheet, presentation maker, PDF reader, file manager and even a calculator.

Since the Eee PC was also aimed at children, a tab called Learn offered apps relating to science, language and maths (there's a paint program, too). Under Play, Asus offered a media player, music manager, photo manager, video manager, games, sound recorder and a webcam. Then there was Settings, with important stuff such as the printer setup and software installation. The most used apps could go into the Favourites tab.

The Eee PC 701 has a solid case and feels very robust.

Back to the future

A lot has changed over the past decade and a half, including expectations. To that end, I wanted to see if those apps were not only useful but enough to satisfy me as a modern user and, crucially, whether everything still works as expected. As you can imagine, there were some niggles.

Getting the Eee PC hooked up to Wi-Fi proved more difficult than I imagined, with the machine telling me the attempted connection was "pending". I vaguely remember this being an issue in 2008 (a quick search showed forums pleading for a solution for a few years after; it appeared there was an issue with the Wi-Fi driver). After a lot of persevering, I finally got online. I'd like to say this was because I'd switched to WPA and delved into the settings to allow the use of any Wi-Fi channel but, alas, this didn't always work on subsequent attempts. Temperamental beast, this one!

With the Eee PC finally online, it was time to check those apps. Google Docs was a non-starter, as I suspected – Eee PC uses Firefox 2 and it had trouble with the site's certificate. Likewise with Wikipedia, since it was deemed to use a security protocol that isn't enabled. I raised my eyebrows before even clicking Skype (it's the 2.0 beta!) and didn't even bother logging in. But I launched OpenOffice 2, and I was, at last, able to do something of note.

OpenOffice is a decent enough office suite – an open-source version of StarOffice that appeals to me for the sheer geeky fact that its roots extend back to the Amstrad CPC. This version was created well before OpenOffice.org became Apache OpenOffice (and before people began moving over to LibreOffice), but it still stands up well. The word processor in particular is sufficiently feature-packed to make the device useful today. My biggest gripes are the lack of an ever-present word count and an inability to save docx files (doc and odt are fine).

You can also export documents as PDFs and, by using the Printers app, you could try setting up your wireless printer. I was able to

connect to my Epson XP-900 by selecting Other as the Network Type and allowing the computer to scan for printers. Once found, it was a simple matter of going into the printer's properties and choosing the closest-looking printer to my own. "Hello World" was outputted in seconds.

You're fired!

In truth, the office suite is the main reason for using the Eee PC 701 in its original form today. Although you can browse the web, the fact that you'll need to do so using Firefox 2 is limiting – far too few websites will launch. If you did decide to find and use one of these devices as a writing machine, though, you could do so without even going online.

Indeed, by saving files to memory cards (inserted in a slot handily placed to the right of the device), it's easy to move your documents from the Eee PC to another computer. Three USB 2 slots also allow the use of external storage devices such as hard disk drives and flash sticks, and you can make use of an external DVD drive.

In that sense, the 701 still makes for a great writing tool to take on the road (or train). And I had few issues with the 7in screen, despite its low resolution of 800 x 400. While it's admittedly nice to have more screen space as standard (the main bugbear is having to scroll more), there's always the option of a VGA output that allows the device to be connected to a larger display.

It's also worth noting that later model Eee PCs came with 9in and even 10in screens, so there are options out there if you're considering snapping up one of these devices today (the later models also had more storage, memory and better battery life).

Even so, the main problem was and remains the cramped keyboard. Although I used the device in the 2000s and managed to write long-form articles on it, today that just feels far too uncomfortable. The keys are too small and they're only a millimetre apart rather than the standard five or so, leading to multiple mistakes.

There are also frustrating oddities, such as the numerical keys being ever so slightly to the left of the top row of letters – I kept hitting "2" when I meant to bash "1". Oh, and the trackpad is just a bit too small and requires a lot of finger swiping to perform most tasks. A deal breaker? Not really.

Above: The Eee PC looks as stylish today as it did when it was launched in late 2007.

For short blogs, notes, letters and so forth, the Eee PC 701 remains perfectly usable – arguably better than the onscreen keyboard of an iPad, the device that effectively killed the netbook market by offering something more practical. So while Steve Jobs swished aside netbooks as "just cheap laptops" during the iPad launch in 2010, saying, "they're slow, they have low-quality displays and they run clunky old PC software", he overlooked the benefits of a set of physical keys.

Not that the netbooks really had a future, you understand. The big blow came when netbooks were being offered with Windows 7 as standard and the cost of buying them began to rise. Manufacturers didn't seem to mind letting them go because

netbook sales had grown so much (taking 20 percent of the portable computer market at one stage) that they were eating into the more lucrative laptop sector.

Game on

But I digress. The netbooks certainly had charm and there was also a sense of fun about them. In the case of the Eee PC 701, users could entertain themselves with a game of *Solitaire*, *Tetris* or *Sudoku*. Asus offered a few kid-friendly titles such as *Penguin Racer*, *Frozen Bubble*, *Potato Guy* and *Crack Attack*, too.

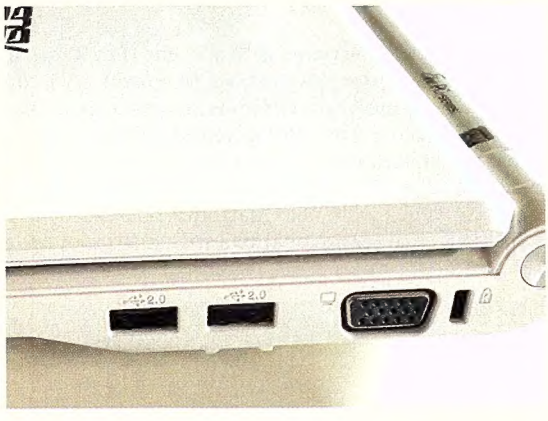
The device also supported a host of video and audio files, including WMV, MP3, WMA, WAV, MPEG-4, DVD and AAC, and you could use the tiny screen to view images in formats such as PNG, JPG, TIF and BMP. Those wanting to take their own images (still or moving) could use the 640 x 480 resolution camera just above the display and the built-in Paint program was not unlike the Microsoft equivalent.

Tunes could be pumped out at a decent level through the two speakers either side of the screen, but a pair of external speakers or headphones plugged into the audio jacks were a wise investment. I did try using the device as an interview machine and found the results were rather good. The only downside is that the microphone is strangely placed underneath the device, muffling the sound recordings.

You're not stuck with having to use the built-in apps. Go online and you'll likely find better programs to download and try on the device. The big problem here is that you don't have much space to play around with. The existing apps and system resources take up 63 percent of the storage. And get this: you can't free up space by removing any of the preinstalled apps. It's so frustrating!

Rather than squeezing in a bunch of additional Linux apps, then, it may be preferable just to ditch the built-in OS entirely and opt for Windows XP. The manual came with full instructions and the process entails connecting a DVD-ROM drive, grabbing a Windows XP disc and a USB flash drive and making use of the bundled Eee PC support CD.

I'd hazard a guess that most people making use of an Eee PC today would forgo the restrictive original setup. Indeed, ever since the device was launched, the Eee PC series has become something of a hobbyist range; blogs written as early as 2008 were already encouraging users to replace Xandros with Windows or a different Linux distro.



Above: The keyboard is cramped, but some claim they can bash out 100 words per minute. **Above:** As well as USB ports, there's an SD card slot and a handy VGA output.

Hardware hacks

Popular hacks have included upgrading the storage, adding Bluetooth and replacing the display with a touchscreen. An easy expansion is to insert an internal USB hub in the space around the screen, and it's also possible to add a card reader, FM transmitter and even a faster chip (one user upgraded to a 1.6GHz Intel Pentium M LV 778).

For those interested in picking up an Eee PC to see how far they can push it, there's a comprehensive wiki at **https://beta.ivc.no/wiki/index.php/Eee_PC_Internal_Upgrades** that shows how the modifications can be achieved. It includes a raft of possible upgrades ranging from a SIM card reader to a way of disabling the fan to save power (the battery, as standard, runs for about three hours between charges). There are Raspberry Pi-based mods you could try, too.

One of the most intriguing hacks I've seen involved shoehorning a ZX Spectrum Next board inside an Eee PC 701. The ZX Spectrum Next was introduced in 2017 as a reimagined version of the ZX Spectrum from 1982, boasting an improved operating system, higher-resolution graphics, more memory and extra colours. The Eee PC 701 hack added portability to the list. It was mighty impressive.

In truth, despite the merits of a dusted down, unexpanded device, such hacks are necessary if you want to make the most of an Eee PC 701 today. But, by opening one up and exploring the internal upgrades, you'll find yourself with a versatile device that can be taken almost anywhere without weighing you down.

The result would also be a machine that still looks as great today as it did then, and you could sit in front of it with glee, knowing you've shaped it into a device that works well for you (it's better than sending it to landfill, that's for sure). In fact, we'd wager you'd still turn heads on a train if you took one along for the ride. Just don't expect to do much work if you do. ■

CHIP CHAT

JOEL BURGESS REPORTS ON THE UNUSUAL SIDE OF TECH NEWS

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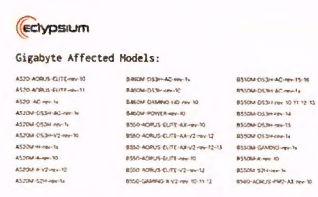
THE DYSON ZONE AIR PURIFYING HEADPHONES ARE 'A DISASTER'

'All I need is the air that I breathe, and some headphones'

Dyson, a company that usually makes vacuum cleaners that look so amazing you'll spend three times as much as you need to on one, decided to follow a different design ethos with the Dyson Zone air purifying headphones. The *Mad Max*-style air-purification mask isn't quite as shocking looking as it was when it was first announced, but as *Tom's Guide* Writer Kate Kozuch points out, between bulky carry cases and impractical battery life they're not an ideal aeroplane travel companion. The Dyson Zone also doesn't offer fine enough particulate filtering to be effective at removing airborne viruses or bacteria, which seems like a critical function.

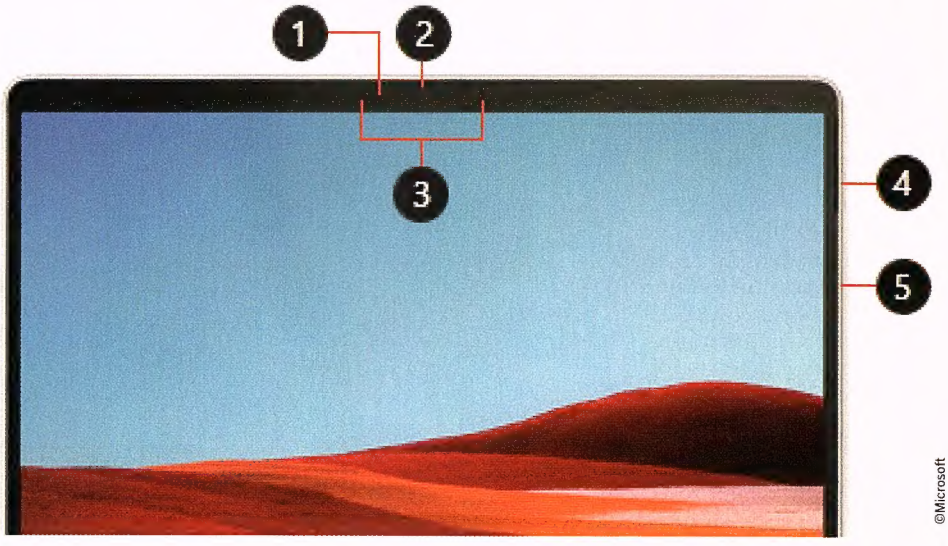


© Eclypsium at bit.ly/3MOOdSH

PC RESEARCHERS FIND BACKDOOR VULNERABILITY IN MILLIONS OF GIGABYTE MOTHERBOARDS

Gigabyte tried to make mobo updates easier, but opened the door to hackers in the process.

If you have a Gigabyte motherboard you might want to think about heading over to the website of cybersecurity company Eclypsium at **bit.ly/3MOOdSH** to see if your board is one of the millions it found to have had a backdoor built into it. The issue, which was first reported by Wired, is a piece of code in the UFEI firmware of 271 current Gigabyte motherboards that fires up on boot and automatically initiates an updater program that can download and execute software underneath the control of an admin. While intended to keep the mobo running smoothly Eclypsium claim that it's implemented insecurely, making it an easy access point for backdoor malware.



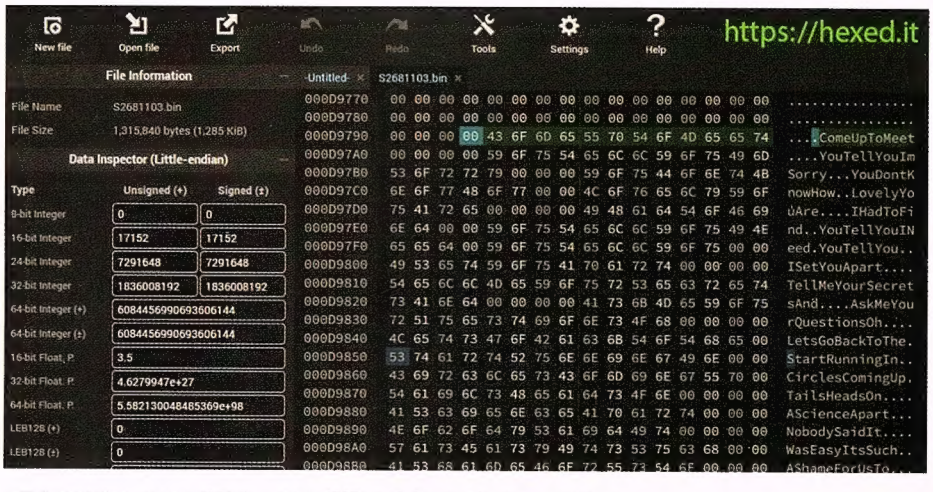
©Microsoft

CHIP CHAT

Surface Pro X cameras had an in-built software bomb

Suspected security 'enhancement' ensures that no one is spying on you.

Back in late May everyone with a Surface Pro X may have noticed their webcam suddenly and irrevocably stopped working. Microsoft's LTE connected tablet didn't care if you had an important online work conference or you were in the middle of an OnlyFans webcam exchange, your Surface Pro X webcam was about to turn off and there was nothing you could do about it. At the time it became a bit of an online mystery amongst vocal Reddit users who speculated that it was a faulty security patch with an arbitrary end date, but Microsoft quickly blamed Qualcomm for a faulty driver and released a temporary patch offering reduced functionality until a full driver update could be issued.



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SECURITY RESEARCHER FINDS COLDPLAY LYRICS IN KINGSTON SSD FIRMWARE

Maybe an attempt to prevent the M.2 from overheating?

Security researcher and reverse engineer, Nicholas Starke, was trawling through an SSD controller firmware in May when he was unexpectedly smothered by Coldplay lyrics from early millennial banger: The Scientist. The talky-bit of this non-consensual earworm had been tucked away in a bin file of a Kingston SKC2000_S2681103 controller firmware that runs on Kingston KC 2000 M.2 SSDs. We're not sure if the coder that wrote the 2020 firmware update wanted Coldplay to succeed where U2's force-fed Songs of Innocence massively failed, or if they were trying to create a software replacement for M.2 heat-sinks, but whatever the reason it can be agreed that it was code that had just the right amount of TMI. ■

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